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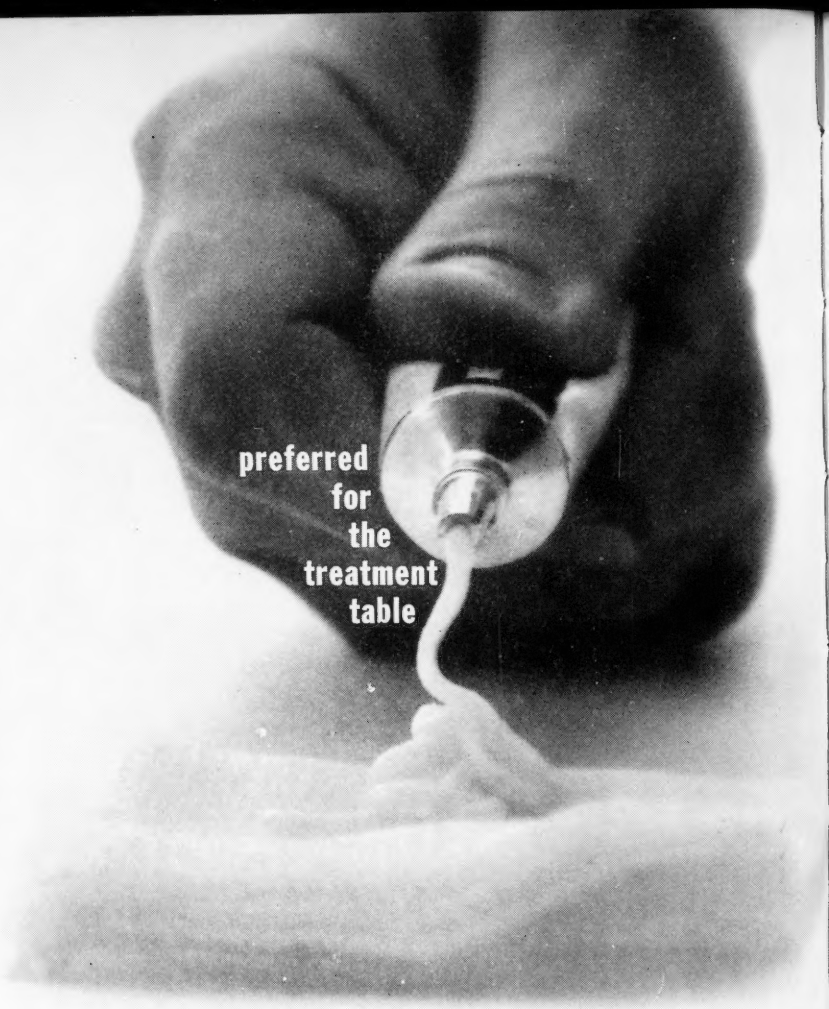

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Association Activities

Chest X-Rays — Benefits vs. Hazards

The following is a joint report of the Committee on Chest Diseases and the Committee on Radiation of the Industrial Medical Association, submitted to the Board of Directors on April 29:

The Industrial Medical Association has for many years advocated that preplacement and periodic chest roentgenograms be utilized in industry for the early detection of pulmonary and cardiovascular diseases of infectious, neoplastic, traumatic, or congenital origin. Early detection offers the best opportunity for cure or amelioration. The optimal interval for chest x-rays is considered to be one year, as longer periods may result in considerable spread of the pathological process before detection. Where budgetary requirements impose restrictions, it is generally agreed that the loss due to increasing the interval between periodic chest x-rays is much less in employees under 40 years of age.

The need to limit the radiation exposure of individuals and whole populations to the lowest practicable amount is recognized. Diagnostic radiology is one of modern medicine's most valuable tools. Basically, the problem is one of balancing the best estimate of the risk of diagnostic x-ray exposures for both the population and the individual against the probable gains to either. The balance can be affected by changes in actual exposure, the estimate of the quantitative effects of exposure, or the probable value of the procedure. For example, the value of chest roentgenograms is increased by improved methods of treatment of cancer of the bronchus while it is diminished by the decreasing incidence of tuberculosis.

There has been much loose thinking and writing among physicians as well as lay people in considering radiation hazards. We fail to differentiate between acute and chronic, whole body or limited exposure, somatic or genetic damage, and this results in confusion.

Animal experimentation has shown quite conclusively that ionizing radiation is capable of causing genetic mutations, increasing the incidence of leukemia, and shortening life span, as well as many other effects. However, attempts to extend quantitative dose effect relationships from animal to man has resulted in considerable confusion and in far more apprehension than seems warranted if we accept the best informed opinions at the present time. Knowledge of the value of periodic chest x-rays, while more complete than that of potential damage from radiation, still leaves much to be desired. With this background it is not surprising that the Board of Directors of IMA has asked the Radiation and Chest Committees to make a statement regarding the existing policy of utilizing chest x-rays in preplacement and periodic examinations. It should be realized that any statement is based upon present knowledge and present practices. There is no reason to feel that these will undergo any dramatic change in the near future; nevertheless, the statement should be reviewed periodically by the pertinent Committees.

Recommendations

After carefully reviewing information now available and comparing the expected gain from a program of preplacement and periodic chest x-rays in industry with the loss due to the radiation exposure, the members of your Chest and Radiation Committees unanimously recommend continuation of the present policy which urges that such service be made available to all employees. Further:

1. The potential somatic hazards of leukemia and other blood dyscrasias, life-shortening, and cancer were considered. The risk of these from properly conducted chest x-ray examinations is considered to be low as compared with the saving or prolongation of life through the use of periodic chest x-rays. Some type of abnormality is detected in about 3% of individuals included in mass chest x-ray examinations.
2. In all diagnostic x-ray examinations, including those of the chest, efforts should be made to obtain an irreducible exposure to gonads and somatic tissues by the use of the most improved methods, equipment, and installations. Unnecessary x-ray procedures should be avoided. Modern x-ray equipment should be properly installed and used, with adequate voltage, collimation, filters, and shielding. The combination of screens, film, and developer should give good definition with minimal patient dosage. An expert should survey each installation. Personal gonadal shielding devices are particularly important when the gonads are by necessity or through carelessness in the primary beam. Roentgenographic large-film x-ray units are preferable to the photoroentgen units for chest examinations of employees who are potentially exposed to radiation at work, because of the lower radiation dose to the chest. When such precautions are taken, the gonad exposure from 1,000 chest x-rays is about equal to that from one x-ray examination of the hips.
3. The Industrial Medical Association and its members should encourage and support all efforts to improve the available data on (1) the value of periodic x-ray examinations and (2) any evidence of deleterious effects that have resulted from these procedures.
4. The Committees should periodically review the above statement.

—W. D. NORWOOD, M.D., Chairman, Committee on Radiation, and HARRY E. TEBROCK, M.D., Chairman, Committee on Chest Diseases.

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The Industrial Medical Association was organized in 1915 as the American Association of Industrial Physicians and Surgeons. Its first annual meeting was held the following year. In 1951 the present name was adopted.

The purposes of the organization as stated in the certificate of incorporation (not-for-profit) are:

"The object of this Association will be to foster the study and discussion of the problems peculiar to industrial medicine and surgery; to develop methods adapted to the conservation of health among workers in the industries; to promote a more general understanding of the purposes of the medical care for employees; and to unite into one organization members of the medical profession specializing in industrial medicine and surgery for their mutual advancement in the practice of their profession."

Presently, the membership totals nearly 4000 physicians in the United States, Canada, Latin America, and other parts of the world. Physicians "who have an interest in Industrial Medicine" may apply for membership; specialization in this field is not essential. Regionally, the Industrial Medical Association has 14 Component Societies in the United States and one in Hawaii. Most Association members carry their membership through one of the component groups.

The Journal of Occupational Medicine, owned and published by the Industrial Medical Association, is sent monthly to each member as one of the advantages of membership.

The annual business meeting and convention is held in the spring. Since 1945, the convention has been held concurrently with the meetings of four other organizations having related interests—American Industrial Hygiene Association, American Conference of Governmental Industrial Hygienists, American Association of Industrial Nurses, Inc., American Association of Industrial Dentists. This combined meeting is known as the Industrial Health Conference.

The Occupational Health Institute, Inc., is a nonprofit educational organization created by the Industrial Medical Association to promote the cause of health in industry. Since 1951, the Occupational Health Institute has conducted the program of evaluation, approval and certification of Medical Services in Industry, on the basis of standards established by the Standards Committee of the Industrial Medical Association. This program was conducted by the American College of Surgeons for many years until its transfer to the Association.

The Association's headquarters office serves as a focal point for the Association's activities, and through its coordination of information regarding industrial health problems encountered throughout the country, it offers invaluable assistance to members on a host of specific subjects.

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Brachial Plexis Block for Hand Surgery

Experience at Henry Ford Hospital—600 Cases

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BRACHIAL plexus block anesthesia is usually safe and efficient. Whether or not it is the ideal anesthesia for hand surgery is open to some question. In our institution, for the past several years, however, we have considered it the anesthetic of choice for this surgery. Because of antipathy to this type of anesthesia, we were stimulated to look more carefully, not only at the experience of others as reported in the literature,[1-3] but also at our own experience. In an excellent review article published in 1949 by Bonica,[2] the statement is made that a perusal of American literature reveals an insufficient number of articles written about brachial plexus block anesthesia. He states that the popularity of brachial plexus block anesthesia is less than it should be, often owing to misconception existing among surgeons and anesthesiologists regarding the production of satisfactory block, the time-consuming administration and difficulty of the block, and the relative simplicity of theopental (Pentothal) sodium. Bonica indicates that there is an impression that intravenous anesthesia is, in general, a safer and simpler method of anesthetizing patients for surgery of the upper extremity. In reviewing the American literature, he notes that the first article was published in 1884 by Halstead. Including the series by Moore and Bonica, there were by 1950 approximately 2,500 cases reported in the American literature. It is of interest that in 1928, Kulenkampff[4] reported on 1,000 cases all of whom had excellent results except for minor procaine reactions in two cases and one case of brachial plexus irritation. A larger series of 1,512 brachial plexus blocks was reported by Bonica and Moore[3] in 1950. These blocks were performed by personnel with many different skills, and it is of interest to note that the percentage of pneumothoraces, which they considered to be their most serious complication, was 0.66. They also report four cases of transient ulnar paresthesia and seven miscellaneous reactions, which in most instances was temporary chest pain. These authors reported that in 93% of their cases there was perfect anesthesia, in 4% partial, in 3% no anesthesia. It is interesting to note that of those cases with "perfect" anesthesia, 24% required the addition of complemental anesthesia which ranged from theopental and nitrous oxide through 5% alcohol infusions and morphine injection.

Methods

Between September, 1954, and September, 1957, our records indicate that 600 brachial plexus blocks were done in Henry Ford Hospital. Of these, 74 cases were excluded from this study because they were not done for hand surgery per se or there was inadequate follow-up. The remaining 526 blocks were performed on 440 patients, 38 having undergone two operations with brachial plexus block anesthesia, 14 patients having three blocks, four patients having four blocks, and one patient having five separate operations under brachial plexus block anesthesia. The use of brachial plexus block was limited to those cases in which the

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TABLE I—PHYSICAL STATUS

Elective	Emergency
P.S.	P.S.—E
1. 36.7%*	1. 37.75%
2. 9.4%	2. 12. %
3. 1.4%	3. 2.5 %
4. 1 case	4. None

*% of 526 cases

other logical choice was general anesthesia. We do not feel that brachial plexus block is a substitute for good local anesthesia wherever it can be used. In our opinon, flexor tendon repair and other major reparative surgery of the hand is not performed satisfactorily under local anesthesia. Of these 526 blocks, 326 were done by anesthesia residents, 68 by surgical residents who at the time were rotating through the anesthesia service, and 124 by staff anesthesiologists. The success of the block was judged by two criteria: (1) whether it was successful from the surgeon's point of view and (2) whether it was successful from the anesthetist's point of view. In many cases, a brachial plexus block giving only partial anesthesia of the hand was successful for the surgeon, inasmuch as the area on which he was operating was anesthetized and provided him with suitable operating conditions. The anesthesia department, however, would consider a block such as this only partially successful.

As noted in Table I, approximately one-half of the patients in this report were admitted as an emergency for immediate surgery. An equal number, whether for emergency procedures or routine elective surgery, were of physical status I. When these records were analyzed, it was noted that a majority of the blocks were given to patients who were not fit candidates for general anesthesia. There were in this category a large number of patients with trauma who arrived in the emergency room having eaten a short time before. There is an increasing number of patients who are on maintenance drug therapy or who have recently been on therapy such as the steroids in which there is a possibility of induced adrenocortical insufficiency and in whom general anesthesia must be viewed with more than casual apprehension. In diabetes mellitus, the interruption of regular food intake, necessitated by the use of general anesthesia, also would lead one to use a brachial plexus block where feasible. Geriatric or the debilitated patients withstand brachial plexus block with less evidence of stress than when general anesthesia is used. These factors are involved in our selection of the method of anesthesia. In our series, the youngest patient was seven years old and the oldest 78, with a mean age of 40 years. This study was undertaken at a time when brachial plexus block anesthesia was nearly a "routine" for hand surgery. Approximately 200 blocks per year were being performed. Subsequent to the early findings herein reported only 100 blocks have been done per year. The significance of this is discussed later.

Results

One of the most frequent criticisms of this form of anesthesia is that patients object to its administration and that the performance of this block is so time-consuming that it delays the operative schedule. We admit that the patient who enjoys being stuck with needles is in a minority, but among our group, all of whom were private patients, there have been few, if any, vociferous complaints about this method of anesthesia. The complaint that the institution of this anesthesia is time-consuming and holds up an operating room has not been substantiated by our findings. The average time for administering a satisfactory block has been between 5 and 10 minutes. There are cases which require more time, and on occasion there is justification for this complaint. However, this same criticism can be made of general anesthesia, where the safe induction time is not much shorter than that required to establish a brachial plexus block. On the basis of anesthetic criteria, those blocks which were considered pure technical successes, i.e., complete anesthesia of the brachial plexus with the first injection, were most often performed by the staff anesthesiologist (81% of their blocks), whereas the surgical resident and the anesthesia resident had approximately the same degree of success from the point of view of a complete block (73% of their blocks). In Table II, Section A, will be noted the results of the

TABLE II—SUCCESS OF 526 BRACHIAL PLEXUS BLOCKS

A. By surgeon's criteria			
I. Complete success	449 Cases	(85+%)	
II. Partial success—Small amount of local added	46 Cases	(9+%)	
III. Wholly unsatisfactory	23 Cases	(4+%)	
B. By anesthetist's criteria			
I. Successful			
a_1 Pure technical success 1st injection		(75+%)	85%
a_2 Incomplete block but satisfactory for surgeon		(8+%)	85%
a_3 1st injection failed—success with 2nd injection		(1 %)	85%
II. As above—surgeon and anesthetist criteria alike			
III. As above—surgeon and anesthetist criteria alike			

blocks as viewed by previously outlined criteria established by the surgeon, in which there were 23 blocks, or 5%, that were totally unsuccessful, 46, or 9%, that were partially successful, and 449, or approximately 85%, that were completely successful. As noted in Table II, Section B, judged by the anesthetist's criteria, only 75% were pure technical successes with another 10% being satisfactory for surgery solely because of a fortuitous operative site as previously outlined. The use of an anesthetic method which provides only 85% complete success on the first administration might be viewed with some misgiving but, as pointed out, under "Methods," the majority of these patients were not ideal candidates for general anesthesia.

Technique of Block

All patients were given preanesthetic medication prescribed according to weight and age and consisting in general of a barbiturate given one and one-half hours prior to the anesthesia and a narcotic with a belladonna drug one hour prior to anesthesia. While it was hoped to have the patient comfortably sedated, we tried to avoid over-premedication, since during performance of the block paresthesias were always sought. Some of the failures to obtain a successful block were related to the inability to obtain paresthesias. In some cases, premedication was considered excessive and the patient was unable to cooperate with the eliciting of paresthesias. This was not universally true, however, for an equal number of patients who did *not* have paresthesias obtained a satisfactory block. The supraclavicular approach, described by Kulenkampff,[5] Labat,[6] Macintosh and Mushin[7] and others, was employed in all cases. In brief, the instruction given our residents is as follows: The patient is placed on the operating room table with the side to be blocked on the table so that the arm can be placed close to the body with the palm to the side of the thigh and extended toward the feet. No pillows are used under the patient's head, and the head is turned opposite to the side to be blocked. A wide area of the neck and shoulder is prepared with antiseptic and appropriately draped, caution being exercised to allow the patient to breathe beneath the drapes and prevent claustrophobia. It is important to explain to the patient that pressure and occasional fleeting discomfort in the supraclavicular area will ensue but that he is to remain quiet and motionless and indicate by voice signals alone when something like electricity which goes anywhere between the elbow and the fingertips is felt. He is also instructed to tell the anesthetist whether the electrical-like feeling goes to the little finger side of the hand, the thumb side, the wrist, or the elbow. The anesthetist standing to the side and facing the head of the patient palpates the supraclavicular area for maximal pulsation of the subclavian artery. A second landmark is obtained by having the patient approximate the lips and puff the cheeks in order to demonstrate the position of the external jugular vein. The midpoint of the clavicle is also ascertained. With these general landmarks in mind, a skin wheal using procaine is made approximately two fingerbreadths above the clavicle, near its midpoint closest to the point of maximal pulsation of the subclavian artery and either medial or lateral to the jugular vein, whichever seems to be more feasible. A 22 gauge 1½-inch needle is then directed through the skin wheal with the right hand, while the left hand depresses the supraclavicular structures and at the same time attempts to maintain continuous palpation of the subclavian artery. We instruct the resident that the depth of the first rib, which is frequently sought in attempting brachial plexus anesthesia, is very shallow and that rarely is it necessary for the needle to advance 1 inch beneath the surface. It is pointed out that whenever the needle need be advanced more than this beneath the surface, reappraisal of the direction of the needle and of the palpating left hand must be repeated in order to assure oneself that the direction is proper. Having made contact with the rib and eliciting no paresthesias, the needle is slightly withdrawn outward and then walked upon the first rib medially and laterally through the same skin wheal. In nearly all cases, this is satisfactory in producing paresthesias to one or more of the divisions of the brachial plexus. The anesthetic solution is then injected with a slight quivering motion of the needle so as to place the anesthetic solution in the position where it will best diffuse through the different fascial planes. It is to be remembered that the brachial plexus lies outward or above the first rib and that the needle must not be on the first rib for the best results. Occasionally, when paresthesias are not satisfactorily obtained from this procedure, a second skin wheal is made 2 cm above and lateral to the first skin wheal and the same procedure repeated. Once a very definite paresthesia is obtained which appears to be to the hand itself, no further efforts are encouraged toward finding other paresthesias. Occasionally, a paresthesia is obtained in the shoulder and it is important to have the patient describe this paresthesia in order not to confuse it with the sought for paresthesia of the forearm and hand. In the 526 blocks, as-

piration of blood was obtained in only 24 blocks. Anatomically, the ulnar nerve is derived primarily from the medial division, and, as this is the most caudad portion of the brachial plexus, it is somewhat behind the subclavian artery. This perhaps accounts for 44 occasions in which the ulnar division of the plexus was not satisfactorily blocked. There were, however, only 14 instances each in which the median or radial division was not satisfactorily blocked. There was no attempt to maintain a syringe upon the needle. It was felt that a pneumothorax was produced by needle laceration of the lung itself and not from any small introduction of air which might occur through the 22 gauge needle. This is but a brief description of our technique and those interested should consult standard texts of anesthesia. Recent literature has re-emphasized the axillary route to brachial plexus block which is said to be easy and not fraught with some sequelae seen with the supraclavicular approach. More objective data are yet needed.

Drugs for Brachial Plexus Block Anesthesia

During the early part of this study, the drugs available for administration were procaine, lidocaine (Xylocaine), tetracaine (Pontocaine), and hexylcaine (Cyclaine). In the latter part of the series, 2-chloroprocaine (Nesacaine) was made available to us. Procaine was not used because of its generally poor reputation in brachial plexus anesthesia from the standpoint of slowness in onset, brief duration, and frequently patchy anesthesia. Tetracaine alone, though an excellent anesthetic agent, was not used because of the frequent need for rapid onset. It was combined with drugs such as lidocaine, hexylcaine, and 2-chloroprocaine for the purposes of increasing the duration of anesthesia. Lidocaine, 2-chloroprocaine, and hexylcaine also were used individually without the use of lidocaine. The use of 2% hexylcaine was discontinued early in the series because of a rather high incidence of either unsuccessful blocks or blocks of insufficient duration. Lidocaine and 2-chloroprocaine were highly successful when used alone, but the effects were of too short duration. Because of difficult reconstructive surgery or performance of the operation by surgical residents, longer duration was mandatory. It is our opinion that lidocaine 2% with tetracaine 0.1% is the superior combination for speed of onset, efficiency, and duration. However, 2-chloroprocaine 3% combined with tetracaine 0.1% is equally good and perhaps safer for one hour of surgery but is less efficient for surgery lasting over an hour. Local anesthetic reactions have not occurred thus far with 2-chloroprocaine, although 10 minor reactions were seen with lidocaine. Epinephrine was used in a 1:200,000 dilution in all cases to increase the duration of action of the anesthetic as well as decrease the rate of absorption and minimize the number of local anesthetic complications. Supplemental use of intravenous meperidine or pentobarbital was resorted to for patient comfort, particularly where the tourniquet was to be used, since not all patients having pneumatic tourniquet application had a block of the intercostal brachial nerve. Those patients in whom the block was an out-and-out failure received either general anesthesia or local infiltration anesthesia. Among the remaining blocks there was a 20% incidence of complemental use of 40 to 50 mg of meperidine intravenously or equivalent dosages of intravenous pentobarbital sodium for sedation of the apprehensive patient. These patients retained all vital reflexes and were not overly sedated.

Complications

It is difficult to assess the total complications of this type of anesthesia because the great majority of them are subjective and cannot be readily demonstrated. The most readily demonstrable is pneumothorax. In the earlier reference by Moore and Bonica,[3] the clinical impression of 0.66% was obtained. In a subsequent study,[8] 100 consecutive patients with brachial plexus block were followed by routine roentgenograms, and the clinical impression of approximately 1% was confirmed. In our series of patients, chest x-ray films were not obtained routinely but were obtained on 38 patients in whom there was some question of pneumothorax. Ten of these patients had clinical signs such as dyspnea and pain indicative of pneumothorax. Of the 10 with clinical signs of pneumothorax, 5 had negative chest films and 5 showed evidence of partial lung collapse. Three patients had chest roentgenograms because of indeterminate chest pain which was not clinically suggestive of pneumothorax, and in these there was no demonstrable pathology. It is of interest to note that Moore[8] reported in a series of 100 cases not only a 1% incidence of proved pneumothorax but a 5% incidence of vague chest pains. Roentgenography was done on the remaining patients because of some difficulty in administering the block or the withdrawal of blood in the syringe during the administration. None of these patients showed any pneumothorax. We had, therefore, five proved cases of pneumothorax in 526 blocks, which is an incidence of just below 1%. Table

TABLE III—BRACHIAL PLEXUS BLOCK; ALLEGED COMPLICATIONS VS. ANESTHETIC SKILL

Block Performed by	% of Total Blocks	% of Total "Alleged" Sequelae
Surgical resident	12	18
Anesthesia resident	63	61
Staff anesthesiologist	24+	21

III records the sequelae in terms of anesthetic skills. Thirty-three patients had complications which could conceivably be related to brachial plexus block, and these were grouped together and called "alleged" complications. Some of these patients had more than one complaint, so that the 33 patients had a total of 38 complaints. The anesthesia resident performed 63% of the total blocks and had 61% of the alleged sequelae. The surgical resident performed 12% of the total blocks and had 18% of the alleged sequelae, whereas the staff anesthesiologist performed 24% of the blocks and had 21% of the alleged sequelae. There does not seem to be any significant statistical difference between the "proved" and "alleged" complications as to the various groups who administered the anesthesia.

A final breakdown of the complications into three general categories has been made. First, is those in which there is rather definite evidence that the alleged complications are related to the performance of surgery or of original patient disease or to definite psychosis. The second group includes those in which there was early clinical evidence to suggest that brachial plexus block itself could be implicated but after long-term follow-up it appeared rather unlikely that brachial plexus block had any significance, and in the third group the complications seem most certain to be related in one way or another to brachial plexus block anesthesia. This is shown in Table IV. There were attempts made to relate the incidence of complication not only to the skill of the anesthetist performing the block but also to the agents used and to the use of pneumatic tourniquets. This was not statistically possible except in the final breakdown of patients who had sequelae which certainly seemed to be related to brachial plexus anesthesia. Seven patients had the application of pneumatic tourniquet, and three did not. Even in these cases, there appeared to be no definite relationship, in that two of the patients who had definite neurological sequelae had *no* application of tourniquet and one of the two patients who had a pneumatic tourniquet in place had pneumothorax as his only sequela. Several patients with paresthesias were immediately relieved upon cutting of the cast. Two patients who complained of pain and weakness in the hand for one year following their anesthesia were immediately and completely cured when, upon the surgeon's recommendation, they were reclassified in their industrial capacity and given a more pleasant job. The significance of "subjective" complications in patients covered by industrial compensation is well known to industrial physicians. As a corollary to our changed views for brachial plexus block for hand surgery, we are also using more local anesthesia for compensable hernia repairs; and we also note a higher incidence of postlaminectomy pains in the compensable "aching back" patient. Despite a higher accuracy with more successful blocks, our tendency has been to avoid brachial blocks in wholly elective compensable hand surgery.

The difficulty of assessing subjective complaints and relating them to any one portion of the total care can be illustrated by the following case. A young healthy man had surgery in the area of the thumb. The duration of the surgery was 45 minutes. The brachial plexus block was easily accomplished and successful. Pneumatic tourniquet was in place for 30 minutes. The hand was operated on in the supine position on a wooden armboard. Postoperatively, there were paresthesias in the elbow

TABLE IV—BRACHIAL PLEXUS BLOCK—COMPLICATIONS*

Related to Block		*"Alleged" But Disproved Later*		*Definite Surgical Problem or Patient's Disease*	
Injection site tenderness	2	Shoulder pain		Hypoesthesia	
Shoulder pain		By calcific tendonitis	1	distal to skin incision	1
Acute	2	Elbow paresthesia		Reflex dystrophy,	
Delayed	1	By removal of sling	1	crushed hand	1
Paresthesia elbow	2	Ulnar paresthesia		Causalgia,	
Ulnar pain	1	Rx with new job	1	crushed fingers	1
Vague chest pain	7	Rx with cast change	1	Median nerve palsy	1
Musculocutaneous pain	1	Dx—myocardial infarct	1	Poor functional hand	2
Pneumothorax		Median and ulnar paresthesia		Wrist drop, partial	1
Closed Rx	2	Rx—cutting cast	1	Carpal tunnel syndrome,	
Open Rx	3	Chest pain—Rx atropine		persistent	1
Brachioradialis atrophy (?)	1	(gastralgia)	1	Psychotic episode	1

*38 "alleged" complications in 33 patients; 22 proved to be related to brachial plexus blocks; 16 proved to be related to other causes.

which lasted five days. Is this subjective complaint related to the anesthesia? To the tourniquet? Or even to the position on the armboard? Of special interest is an elderly patient who had a left brachial plexus block who complained of generalized aching and pain down the left arm immediately and subsequently postoperatively. Three months later, he was readmitted to the medical service with severe angina pectoris and pain radiating down the left arm which he stated was of the same character as his immediate postoperative pain. Three weeks later, he suffered a massive myocardial infarction. This pain, while under our care, might well have been a misdiagnosis of angina pectoris and we were led astray by our concern over the postoperative effects of the brachial plexus block.

Our most severe complication is that of a 51-year-old man who was operated upon for a deep dorsal wrist ganglion. Postoperatively, he had a pneumothorax and pain in the arm and forearm. This pain has persisted for two years. The patient has returned to our clinic on many occasions. He has gone to three other institutions for advice and treatment and returning after all of these with no improvement and no change in his symptoms. He has been out of work, has lost 30 pounds of weight and has had a distinct personality change. The psychiatrists have definite evidence of a rather large amount of conversion hysteria related to family problems. The neurologists, however, feel there has been some evidence of peripheral neuritis. Whatever the diagnosis may be, here is a man who was successfully operated on for a rather innocuous benign condition and who has been severely disabled by complications which, to some degree, are attributable to the anesthesia. A recent article by Vandam[9] suggests that a thorough neurological examination should be done before all brachial blocks.

Summary

Careful evaluation of 526 brachial plexus blocks for hand surgery indicated 85% to have been completely satisfactory: less than 1% had pneumothorax. Patient acceptability and anesthetic induction time were not problems. Actual complications were significantly few, but those which did occur were either perplexing as to etiology or distressingly difficult to manage.

Subsequent to this study, 130 additional brachial blocks were performed, the criteria for selection being essentially the traumatic industrial admission. This has resulted in far less "alleged" complications. It can be said, therefore, that we have somewhat changed our opinion as to the appropriateness of brachial plexus block for hand surgery; we now consider it the best anesthetic for the emergency admissions, who have usually been unprepared for anesthesia and in whom general anesthesia creates a distinct but often overlooked hazard. This is also true of geriatric patients as well as patients suffering from various disease states, particularly those who are on drug therapy which might produce complications, i.e., cortisone, insulin, rauwolfia, and others.

From this survey, we now feel that brachial plexus block anesthesia is reasonably safe and usually efficient, but for the young healthy adult in whom elective surgery of the hand is to be performed the institution of an anesthetic method which in our hands is only 75% to 85% successful on the first administration is not ideal. Ideally, this procedure should be reserved for patients in whom general anesthesia is definitely contraindicated, i.e., patients who have recently eaten, geriatric and debilitated patients, or persons on drug therapy which might be interrupted by or in which general anesthesia is a hazard.

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References

1. Griswold, R. A., and Woodson, W. H.: Brachial Plexus Block Anesthesia of the Upper Extremities, *Am. J. Surg.* 59:439-433, 1943.

2. Bonica, J. J.; Moore, D. C., and Orlov, M.: Brachial Plexus Block Anesthesia, *Am. J. Surg.* 78:65-79, 1949.

3. Bonica, J. J., and Moore, D. C.: Brachial Plexus Block Anesthesia, *Anesth. & Anal.* 29:241-253, 1950.

4. Kulenkampff, D., and Persky, M. A.: Brachial Plexus Anaesthesia: Its Indications, Technique and Dangers, *Ann. Surg.* 87:883-891, 1928.

5. Kulenkampff, D.: Die Analesthesierung des Plexus Brachialis, *Deutsche med. Wchnschr.* 38: 1878-80, 1912.

6. Labat, G.: Regional Anesthesia: Its Technique and Clinical Applications, Ed. 1, Philadelphia, W. B. Saunders Co., 1924.

7. Macintosh, R. R., and Mushin, W. W.: Local Anesthesia Brachial Plexus, Springfield, Ill., Charles C Thomas, Publisher, 1944.

8. Moore, D. C., and Bridenbaugh, L. D.: Pneumothorax: Its Incidence Following Brachial Plexus Block Analgesia, *Anesthesiology* 15:475-479, 1954.

9. Woolley, C. J., and Vandam, L. D.: Neurological Sequelae of Brachial Plexus Nerve Block, *Ann. Surg.* 149:53-59, 1959.

Acute Effects of Microwave Radiation on Experimental Animals (24,000 Megacycles)

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THE APPLICATION of microwaves has become of increasing interest and importance. Some of the fields in which they find use include navigation of aircraft and surface ships; communication; launching, guidance, and fusing of missiles; heating and sterilization of foods, drugs, and other products; and induction of chemical reactions.[1] The investigation reported here was conducted to appraise the possible hazard that might be associated with microwaves in the operation of certain radar equipment.

Experimental Procedures

Generation of Microwave Energy

Two complete sets of microwave-generating equipment (24,000 megacycles, wavelength 1.25 cm.) were used. Both units were modified from radar sets and operated at an average power output of 20 watts. Type 6551 magnetrons are pulse-modulated with a duty cycle of 0.0006. Peak power output was 40 kilowatts. Primary power was supplied by a 400 cycle alternator and regulated at 115 volts. Measuring instruments were operated on 60 cycle power stabilized by a 10 KVA Sola constant voltage transformer.

A block diagram of the generating equipment set-up can be seen in Figure 1. An auxiliary method for the measurement of power was provided as a check against the power meter and thermistor mount.

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Exposure Chamber

A small, absorbent-lined chamber, equipped with a 10 db standard gain horn antenna directed down upon the animal was employed. The exterior of the chamber was covered with bronze screening for shielding purposes. This allowed the use of an electroencephalograph or electrocardiograph during exposure. A hinged door provided closure and complete shielding of the interior of the chamber. (Fig. 2)

The methods of securing an animal differed. An anesthetized animal was exposed to the energy radiated by the horn antenna merely by placing it on a sheet of microwave absorbent. Unanesthetized animals were restrained from moving out of the antenna beam by use of Plexiglas cages and plastic window screen. Plexiglas ¼ inch thick has an attenuation factor of 1.25 db for plane wave energy at 24 kmc. (Fig. 3), and the plastic window screen

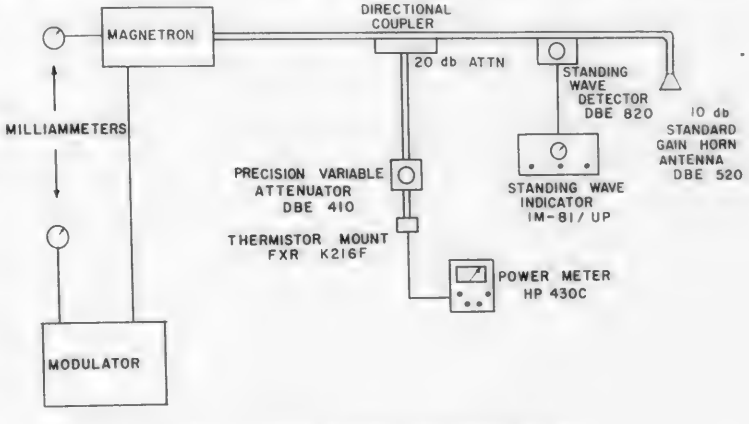

Fig. 1—Acute chamber equipment set-up.

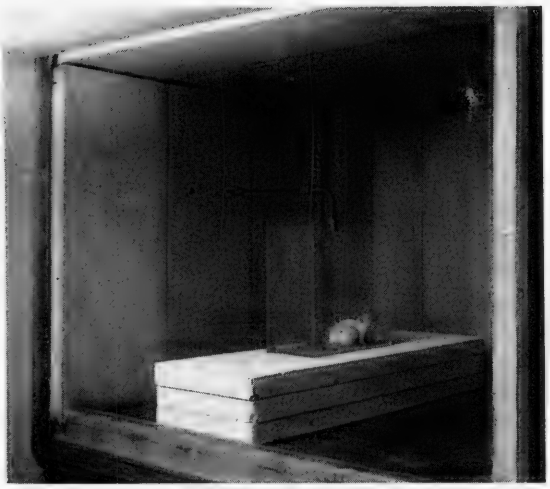

Figure 2

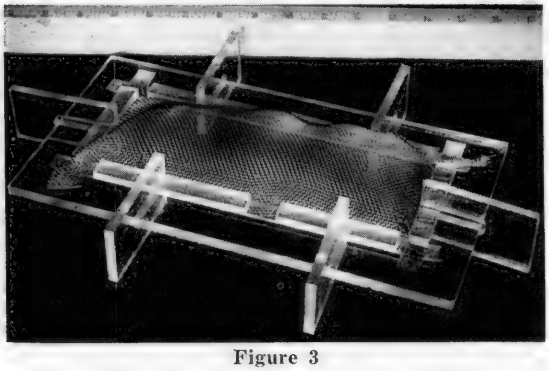

Figure 3

has extremely low attenuation when used in single thickness (well below 0.1 db). Several types of exposure boards for albino rats were used. In general they consisted of a Plexiglas base with a plastic screen cover held in place by plastic clips.

Antenna

A 10 db standard gain pyramidal horn antenna was used exclusively. The reasons for this are: convenient power density calculations from data supplied by the manufacturer of the antenna, fairly symmetrical energy pattern, short near-field distance (5.9 cm.), ability to expose selected areas of the test subject and the ease of changing power density by moving the animal toward or away from the antenna.

Determination of Infrared Power Density

One aspect of these studies dealt with a comparison of the effects of microwave and infrared radiations. By using straightforward calculations it was possible to ascertain the microwave flux density at almost any position in the antenna pattern if power output and antenna characteristics were known.

No calibrated infrared source was available for use in these studies, therefore it became necessary to devise a method of measurement applicable to infrared radiation in order to make valid comparisons of biological effects. A 250 watt General Electric heat lamp was used as a source of infrared radiation, and a calorimetric method of determining flux density was devised. It utilized a thermistor thermometer probe coupled to an integrating heat sink. The heat sink consisted of a disk of aluminum with all surfaces polished except one which is blackened. The dark surface was exposed to the radiant energy and heat flow was determined by calculations which involved the rate of temperature change of the disk, its exposed surface area (blackened) and its thermal mass. A correction factor was applied to allow for heat loss or cooling rate. Assumptions made were: that the blackened surface of the disk was a perfect absorber, that the rate of heat flow was constant throughout the temperature range, and that heat loss was constant.

To help reduce heat loss during measurements, the disk was surrounded with white polystyrene foam insulation which extended the length of the thermistor probe. During use the disk was protected from any unnecessary movement of air which might increase heat loss.

The calorimeter is shown in Figure 4. Calculations of infrared flux densities were made as follows:

Apparent heat flow + heat losses = actual heat flow

$$\frac{Mc\Delta t}{T_1} + \frac{Mc\Delta t}{T_2} = \text{heat flow rate in cal/sec}$$

Where M = mass of disk
c = specific heat of disk
Δt = temperature change of disk
T_1 = time for temperature rise Δt under irradiation
T_2 = time for temperature fall Δt after radiation is removed

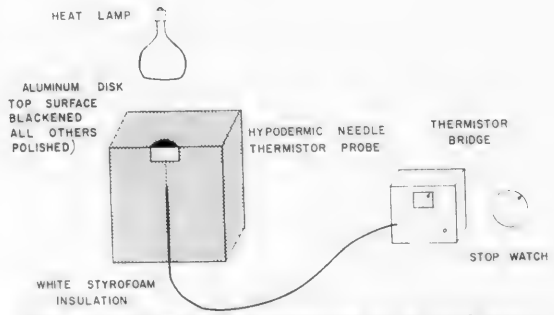

Fig. 4—Calorimetric determination of infrared power density.

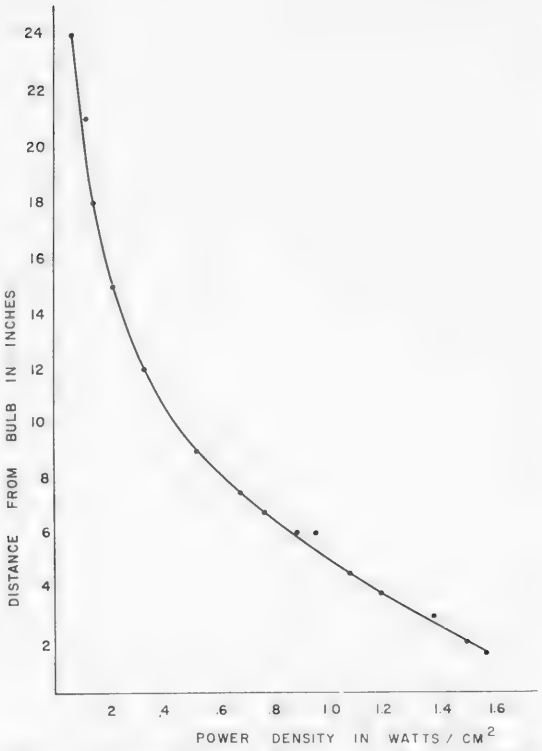

Fig. 5—Infrared power density vs. distance (250 watt G.E. heat lamp with self-contained reflector at 115 volts AC).

Power density $= \frac{J}{A}$ (heat flow rate) joules/sec.—cm²

Where J = 4.18 joules/cal.
A = active (blackened) surface area of disk

Therefore,

Power density $= \frac{J}{A}\left(\frac{Mc\Delta t}{T_1} + \frac{Mc\Delta t}{T_2}\right)$ watts/cm²

For an aluminum disk 1.000 inch in diameter and 0.503 inch thick;

M = 17.95 gm
A = 0.7854 sq in = 5.067 sq cm
c = 0.217 @ 40 degrees Centigrade
Δt = 10 degrees (35-45 degrees C)
T_1 = time for rise to 10 degrees C (35-45 degrees C)
T_2 = time for fall of 10 degrees C (45-35 degrees C)

Power density $= \frac{32.13}{T_1} + \frac{32.13}{T_2}$ watts/cm²

In a test, T_2 was determined to be 936 seconds in still air. Therefore the second term (correction factor) was 0.034 watts/cm².

A power density versus distance curve was run on a 250 watt G. E. heat lamp as shown in Figure 5. A beam pattern check on the same lamp showed a beam width of 40 degrees at half-power points as calculated from a power plot made at a 12 inch radius from the surface of the lamp.

In order to make a comparison between the effects of microwave and infrared energy, it was necessary to alter the energy distribution in the beam pattern of the infrared lamp. By the use of an aluminum foil mask as shown in Figure 6, it was possible to obtain a beam pattern and power density equivalent to that obtained with microwave energy radiated from the 10 db standard horn antenna mentioned before.

Determination of Microwave Power Density

The use of a standard gain horn antenna as a radiator allowed a simple calculation to determine on-axis power density. These calculations are acceptable for any axial distance from the antenna except in the near-field region. Power density was computed as follows:

Microwave power density $= \frac{P_o G_a}{4\pi D^2}$ watts/cm². (2)

Where P_o = generator power output which is available at the antenna, in watts
G_a = power gain of the radiating antenna
D = distance from the antenna in cm

$(D > \frac{2a^2}{\lambda_o})$ (3)

a = major diameter of antenna mouth
λo = free-space wavelength at operating frequency

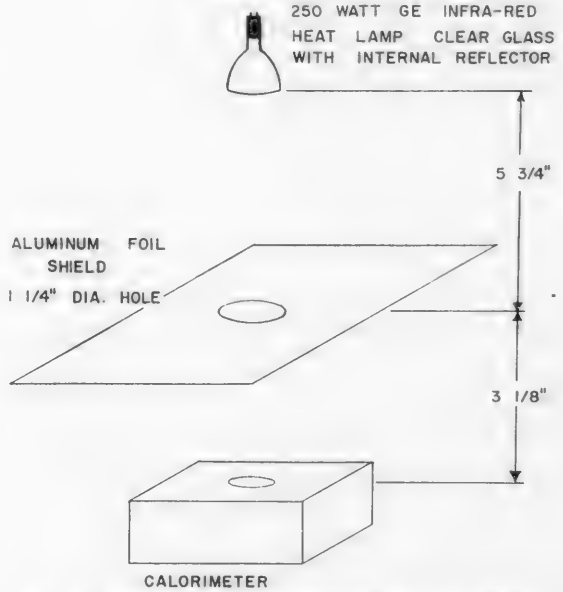

Fig. 6—Infrared power density through mask (power density 0.302 watt/cm², one-half power diameter 2.5 inch corresponding to 3 inch distance under 10 db microwave horn).

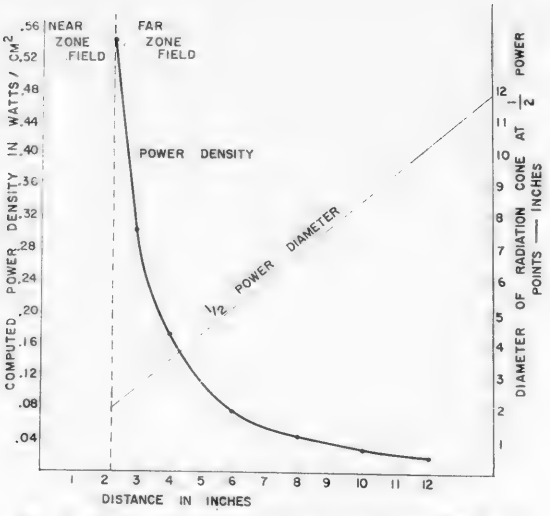
NEAR ZONE FIELD
FAR ZONE FIELD
POWER DENSITY
½ POWER DIAMETER
COMPUTED POWER DENSITY IN WATTS / CM²
DIAMETER OF RADIATION CONE AT ½ POWER POINTS — INCHES
DISTANCE IN INCHES

Fig. 7—Microwave power density and one-half power diameter vs. distance; 21 watts output—antenna gain 10.18 db).

In addition to power density, the size of the irradiated area was important. It is usually defined by the half-power points of the radiation pattern. The "E" and "H" plane radiation patterns of the standard horn antennas used were nearly symmetrical and therefore may be defined by a quantity known as the "half-power diameter." Figure 7 shows typical data for an antenna in use.

While this equipment was operating, power output was monitored constantly and the necessary adjustments were made to assure constant level output. A log was kept of operating characteristics including magnetron and modulator currents, standing-wave ratio, power output, and time. Any deviations from normal operation were immediately investigated. This procedure was found to be necessary because of variations in magnetron efficiency with time.

Measurement of Temperature

The measurement of temperatures in the experimental animals was made in several ways, according to the data required. Both laboratory and clinical thermometers were used for simple measurements such as rectal temperature. Another method involved the use of a thermistor thermometer bridge. Subcutaneous and internal organ temperatures were recorded with a hypodermic needle probe, which, because of its shielding, did not respond directly to microwave energy. Rectal temperatures were taken with a flexible, plastic-covered probe. The thermometer had a range from 35° to 46° C. The thermometer and probes were manufactured by the Yellow Springs Instrument Company, Yellow Springs, Ohio.

Intermittent Exposures

An electronic timing unit was built to provide intermittent operation of the microwave generating equipment. This device is adjustable as to both period and duty cycle. It consists of an astable, asymmetrical multivibrator which drives a switching relay. Excellent stability was obtained at periods of one minute or longer.

For long period cycles manual operation was used. This cycling was used to study thermal inertia effects and approximate the type of exposure that would occur from a rotating antenna.

Results

Single Continuous Exposures

A. Total Body Exposure of Rats and Mice—In order to observe immediate effects, albino rats of Sprague-Dawley stock were restrained and exposed in the near-field at a distance of 3.8 cm from the antenna. The power density in this field could not be calculated. The animals (exposed one at a time) died in 15 ± 2 minutes. The distance was subsequently increased to 7.6 cm (0.26 watt/cm²) which placed the animals out of the near-field. The minimum lethal exposure times were then determined by employing a series of power densities (Table I).

It is of interest to note that a power density of as little as 0.028 watt/cm² produced death of a rat (total body exposure, prone position) when it was exposed continuously for 139 minutes.

Figure 8 was drawn to illustrate the rela-

Table I—Acute Toxicity of Microwaves to the Rat

Rats Exposed, No.	Distance from Antenna Cm	Distance from Antenna Inches	Power Density Watts/Cm²	Minimum Lethal Exposure Time, Min.	Period of Survival after Exposure, Hours
10	3.8	1.5	Near-Zone	4	15
8*	7.6	3	0.26	43	0
11†	7.6	3	0.26	24	15
7	10.2	4	0.15	35	15
6	12.7	5	0.097	45	15
6	15.2	6	0.078	56	15
7	17.8	7	0.057	80	15
9	20.3	8	0.045	91	15
5	22.9	9	0.035	135	0
3	25.4	10	0.028	139	0
3	27.9	11	0.024	450	Survived
2	30.5	12	0.020	480	Survived

(Total body exposure of the rat in the prone position, except as indicated otherwise; the animals weighed from 200 to 257 gm, equally divided as to sex.)

*Head was exposed.

†Lumbar region was exposed.

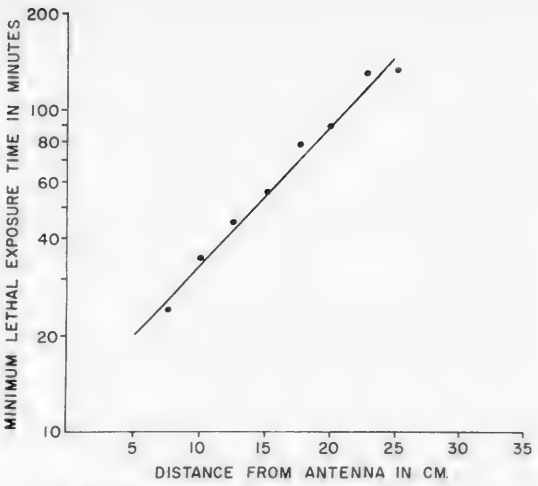

Fig. 8—Acute toxicity of microwaves in the rat.

tionship between the lethal exposure time of a rat and its distance from the antenna. The logarithm of time was plotted against distance. It should be kept in mind that power density is inversely proportional to the square of the distance. If the lethal exposure time for the near-field were included, it would fall below the line. The power density is probably much greater in this zone.

Adult Swiss and C57 mice, equally divided as to sex and weighing from 20 to 40 gm, were exposed similarly. A mouse was restrained in the prone position in a Plexiglas box with an open top which was covered with Saran window screen. All mice were exposed individually. Some were exposed continuously until death. Others received radiation for a certain period of time in an effort to determine the minimal fatal exposure time. These data are presented in Table II.

Signs of Intoxication: Signs of microwave effects were observed immediately in rats exposed on the head in the near-field, that is, at a distance of 3.8 cm from the antenna. The animal was aware of a stimulus and tried to move to avoid it. There was squealing and struggling lasting for 15 to 25 seconds. The ears were hyperemic at first, then turned dark in color. First, second, and third degree burns were eventually produced on the skin directly in front of the antenna. The most conspicuous effect was the stimulation of the central nervous system with muscle spasms, tremors, tail erection and clonic convulsions. Central stimulation was so marked that it aroused a rat from deep, surgical (pentobarbital) anesthesia. Periods of central stimulation alternated with periods of depression, however, the periods of depression grew shorter as the exposure time increased. The rats died without convulsions, apparently from respiratory failure.

Table II—Acute Toxicity of Microwaves to the Mouse

Power Density, Watts/Cm²	Mean Lethal Exposure Time, Minutes	Minimum Lethal Exposure Time, Minutes
0.170	6.3	5
0.120	13.0	10
0.080	19.0	13
0.055	44.5	35
*0.037	282.0	140

(All exposures 10.2 cm from antenna, 8.6 cm half-power diameter; 10 mice per group.)

*Four rats in this group (3 died; one survived 8 hours of exposure.)

When the head of a rat was exposed at a slightly greater distance (7.6 cm; 0.26 watt/cm²), there was similar central nervous system stimulation, but when the lumbar region of an animal was exposed with the same power density, central stimulation was not apparent.

There was no cutaneous burning if the power density was decreased to 0.17 watt/cm² or less. At 0.1 watt/cm² erythema and mild tremors were still noted.

A rise in rectal temperature was observed at all power densities. However, the rate of rise of temperature became less acute as power densities decreased. A rectal temperature of 43° C was quite critical for a rat exposed to these microwaves. When the temperature remained below 43° C, the animal survived.

Mice were hyperactive and had a rise in rectal temperature, but otherwise showed no specific signs. As in the rat, a rectal temperature increase to 43° C or above resulted in death. Signs of central stimulation, such as tremors or convulsions, were not noted. However, the mice were not exposed to power densities exceeding 0.17 watt/cm².

Gross Postmortem Findings (Rats): Exposure of the head in the near-field caused hyperemia with petechial and some diffuse hemorrhages in the subcutaneous tissues. The skin was discolored (greenish-gray). Muscles of the head and neck (directly under the antenna) looked "cooked." The capillaries of the cerebral cortex and meninges were distended with blood and "leaking." In the lungs, there was marked congestion with hemmorhagic areas apparently caused by thrombic emboli. The heart was contracted and filled with clotted blood.

Exposure of the lumbar region to about 0.3 watt/cm² did not cause burning of the skin, but severe hyperemia and diffuse hemorrhages in the subcutaneous tissues. There was more damage to the major organs than was observed

when the head of the rat was exposed. The kidneys and adrenals were inflamed. The liver and spleen were discolored on the dorsal surfaces (nearest to antenna). The lungs and the heart showed changes like those described above. There was dilation of the blood vessels (including capillaries) of the entire gastroenteric tract with diffuse hemorrhages in the mesentery, particularly in the region very close to the posterior abdominal wall.

As the power density decreased, the pathological changes became less severe, but they remained similar. For example, at 0.04 watt/cm², the subcutaneous hyperemia was moderate, the lungs and the kidneys were still slightly congested, and the liver showed disseminated patches of discoloration. With this exposure, the adrenals were still markedly congested. When the power density was reduced to 0.03 watt/cm², there was only slight hyperemia in the dorsal subcutaneous tissue, moderate congestion in the lungs, and slight discoloration of the liver and spleen. At 0.02 watt/cm² there was slight congestion in the lungs.

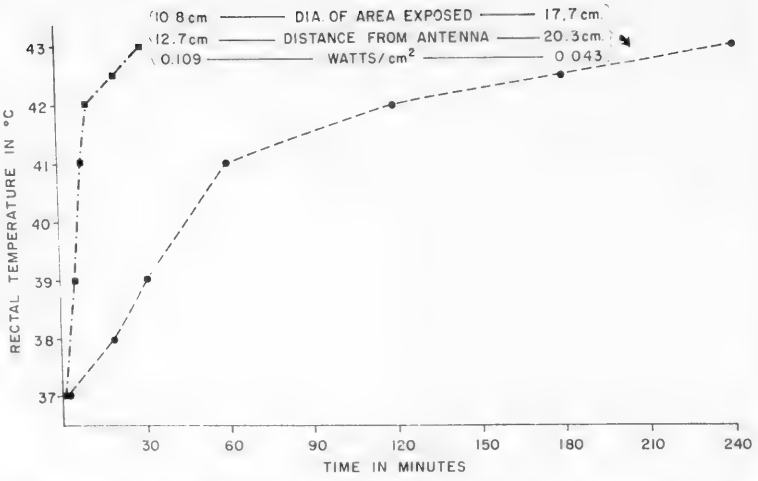

Fig. 9—Effect of microwaves (radar) of different power densities on the rectal temperature of the rat (prone position; continuous exposure until death).

B. Head versus Lumbar and Abdominal Exposure in the Rat—From Table I it can be seen that the lethal exposure time for a rat (prone position) following lumbar exposure was 24 minutes, while it required twice this period (43 min.) to kill when its head was exposed to the same power density. To determine differences in the susceptibility of individual regions of the body, each of one group of 20 rats (10 males, 10 females) received exposure of the dorsal surface of its head. In a similar second group, exposure was directed to the lumbar region; in a third group, exposure was directed to the abdominal area. The power density (0.30 watt/cm² at a distance of 7.6 cm) and the diameter of the areas exposed were kept constant. The mean lethal periods of exposure were calculated from the experimental data. They were as follows:

Exposed Area	Time Required to Kill, in Minutes (Mean ± Std. Error)
Head	18.5 ± 0.96
Lumbar Region	15.5 ± 0.55
Abdomen	12.3 ± 0.53

Because the larger of two rats often survived a longer period of exposure, an attempt was made to correlate body weight with lethal exposure time. The calculated correlation coefficients for each of the above groups were as follows: head 0.145, back 0.662, and abdomen 0.662. A value of $r = 0.662$ corresponds to a P of less than 1%, indicating a statistical significance; consequently it was concluded that the lethal exposure time of a rat was influenced by its body weight, at least when the back or abdomen was exposed. However, the correlation coefficient of 0.145 for the head exposure data does not indicate a significant correlation.

C. Comparison of the Degree of Hyperpyrexia Induced in Various Organs—A number of experiments were conducted to record the rate of elevation of body temperature.

1. Our studies revealed that a rectal temperature near 43°C was critical for survival of a rat or mouse. In the following experiment, six male rats were exposed (prone position) to 0.109 watt/cm², while a similar group of rats was exposed to 0.043 watt/cm². In each case, an animal was exposed until death. The mean rectal temperature was calculated from the experimental data and plotted against time. The thermistor thermometer was employed. The rats of the first group died in about 30 minutes, while Group 2, exposed to about 40% of the power density to which animals of Group 1 were exposed, survived for approximately 240 minutes. All animals died when their rectal temperatures reached 43°±0.5°C (Fig. 9).

2. In another experiment, a rat was immobilized in the prone position and its lumbar region was exposed to 0.30 watt/cm² (half-power diameter 6.3 cm). Probe 1 was placed subcutaneously into the lumbar area directly under the antenna. Probe 2 was injected into the abdominal area—that is, opposite that side

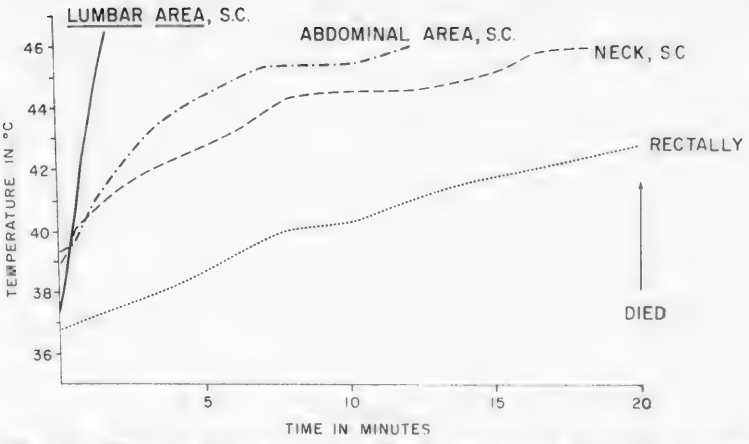

Fig. 10—Effect of microwaves (radar) on temperature in the rat (prone position; lumbar area [6.3 cm diameter]; power density 0.30 watts/cm² at center; continuous exposure).

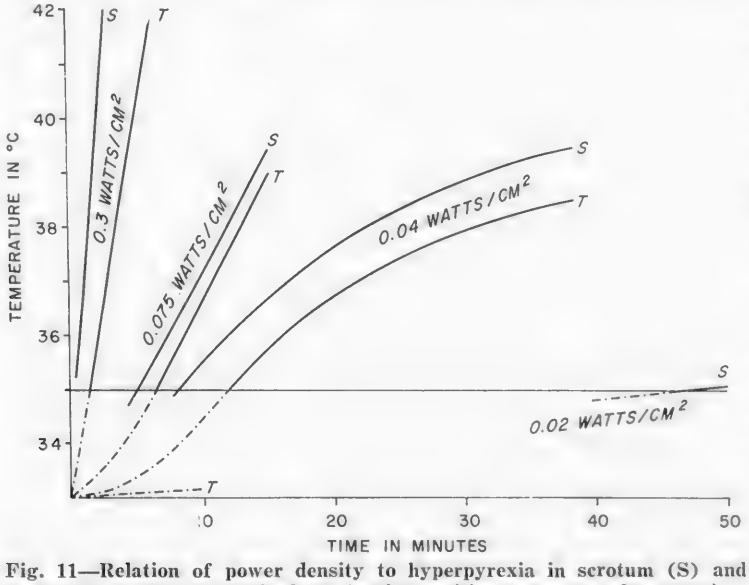

Fig. 11—Relation of power density to hyperpyrexia in scrotum (S) and testes (T) of the anesthetized rat (supine position; exposure of scrotum).

of the rat which suffered the direct exposure. Probe 3 was placed subcutaneously into the back of the neck (outside the half-power diameter), and Probe 4 was placed into the rectum. The temperature changes at these four sites were plotted against time.

As was expected, the subcutaneous temperature rose most rapidly in the area suffering direct exposure. Here, the temperature rose from 37.5° to 46°C in 1.5 minutes. The abdominal area, which had previously demonstrated the highest degree of sensitivity (when compared with head or lumbar exposure), was the second to respond. It took 12 minutes for a rise from 39° to 46°C. The temperature under the skin of the neck rose from 39° to 46°C in 18 minutes, while it took 20 minutes of exposure for the rectal temperature to rise from a control of 36.8° to 42.9° (Fig. 10).

3. In this experiment, an effort was made to determine the temperature changes in the testes and scrotum of the anesthetized (pentobarbital) rat in response to graded power densities. Exposure was directed to the scrotal area of an animal placed in the supine position. The respective power densities and half-power diameters were as follows: 0.30 watt/cm² (6.35 cm) and 0.075, 0.04, and 0.02 watt/cm² (8.63 cm).

The normal intratesticular temperature of the rat is approximately 33°C.[4] Since the instrument permitted measurements only as low as 35°C, temperature curves were extrapolated to 33°C. The results demonstrated again that there is a direct relationship between power density and hyperpyrexia. The temperature in the scrotum rose faster than that recorded in the testes (Fig. 11).

4. In a fourth experiment, temperature increases were determined below the skull on the dural surface lateral to the sagittal sinus in the anesthetized rat (Fig. 12). The recording probe was inserted through an eye in order to leave skin, bones, and circulation intact. Control temperature at the dural surface ranged from 35.8° to 38.6°C. A rat was placed in the prone position, and radiation was directed to the dorsal surface of the head. There were three animals per group. Power densities in watts/cm² and half-power diameters (in parentheses) were as follows: 0.30 (6.35 cm), 0.075 (12.9 cm), 0.033 (19.3 cm) and 0.019 (25.9 cm). The response was almost as marked as in the previous experiment, in spite of the fact that the microwaves apparently had to penetrate the skull (Fig. 13).

5. In the last experiment of this group (12 rats), temperature measurements were carried out in the stomach, spleen, kidney, and liver. The rats had access to food and water until immediately before the experiments. They were anesthetized, placed on their right sides, and exposed to a power density of 0.075 or 0.08

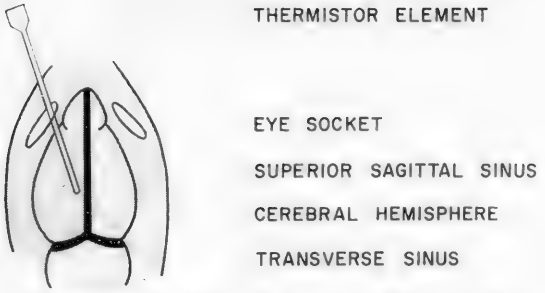

Fig. 12—Dorsal aspect of rat skull, showing placement of thermistor element on surface of dura under intact bone and skin.

watt/cm². The control organ temperatures were as follows: liver 36.4°C (35.6°-37.4°C), kidney 35.8°C (35.0°-37.3°C), spleen 35.5°C (35.0°-36.0°C), and stomach 37.2°C (36.8°-37.8°C). The stomach responded most promptly with a rise in temperature, the liver (left lobe) responded least rapidly, while the spleen and the left kidney took intermediate positions. There was marked variation among animals in respect to temperature changes in the liver. After 25 minutes of exposure, the mean increase in liver temperature was 3.75°C, ranging from 1.75° to 5.75°C (Fig. 14).

D. Effect on the Hemopoietic System—Rats exposed to microwave radiation were examined immediately after termination of exposure to 0.024 watt/cm² for 7.5 hours. Blood from the tail showed an increase in the number of erythrocytes and concentration of hemoglobin. At the same time, there was a decrease in total leukocytes. A blood sample taken 16 to 18 hours after exposure showed a normal erythrocyte count and hemoglobin concentration (Fig. 15) but a further decrease in the number of leukocytes. The polymorphonuclear leukocytes had increased, but the lymphocytes were found to have decreased (Fig. 16). Recovery was almost complete in one week. A second exposure 15 days later induced similar effects and rate of recovery.

E. Local Effects: Microwave Versus Infrared—According to Schwann,[5] microwave energy of frequencies exceeding 3,000 megacycles cause "surface heating" like that induced by infrared or sunlight and penetration of heat, if it does occur, depends on conduction. Several experiments were conducted to compare the effects of these two forms of energy. The following conclusions were drawn from the first study.

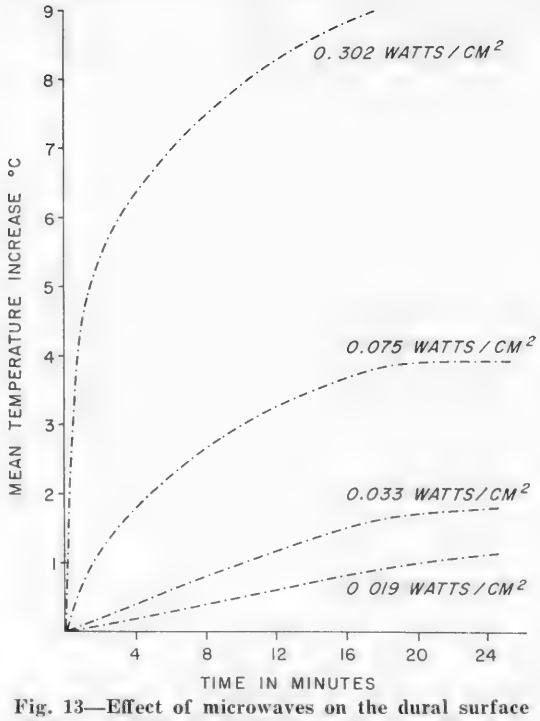

Fig. 13—Effect of microwaves on the dural surface of the anesthetized rat (placed in prone position; exposure of head; three rats in each group).

The obvious skin effects produced by microwaves (0.50 watt/cm²) and infrared (0.53 watt/cm²) were quite similar. However, distinct differences were noted in the underlying tissues. In the rats exposed to infrared, the fascia and muscles were slightly hyperemic, while in the rats exposed to microwaves, fascia and muscles were light gray in color and had a "cooked" appearance to a depth of 5 to 8 mm. While this experiment does not answer the question as to the mechanism responsible for the "cooking" of tissues, it nevertheless shows that microwave

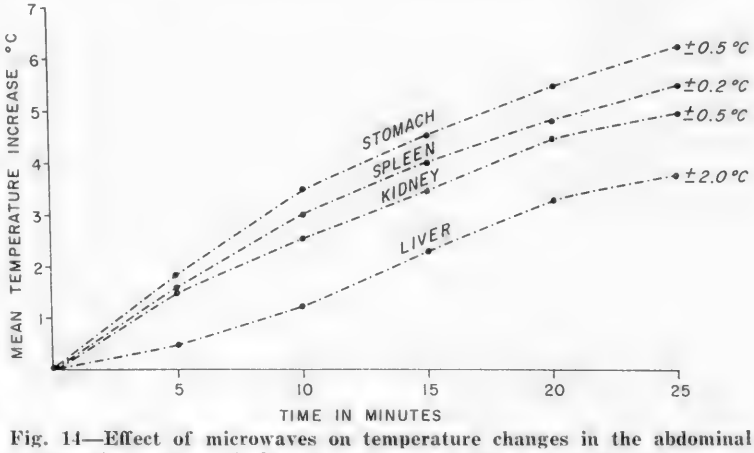

Fig. 14—Effect of microwaves on temperature changes in the abdominal organs of the rat (left lateral exposure; power density 0.075-0.08 watts/cm²; pentobarbital anesthesia; three animals in each group).

effects will penetrate to depths not reached by infrared.

F. Hyperpyrexia: Microwaves Versus Infrared—The following experiments were conducted to compare the hyperpyrexic effects of these two sources of energy in greater detail. The Plexiglas sheet, holding the rat, was suspended about three feet off the floor so that a rat would receive only incident and not reradiated infrared heat.

1. Two groups of six rats each (three males and three females) were employed. The animals were of essentially the same body weight. Employing the plastic animal holder, a rat was immobilized in the prone position and its lumbar area was exposed. Group 1 was subjected to microwaves of 0.17 watt/cm^2 (8.6 cm half power diameter). Group 2 was exposed to infrared of a power density of 0.27 watt/cm^2. The mean rectal temperature changes were calculated from the experimental data and plotted against time (Fig. 17).

Ten minutes of continuous exposure to microwaves resulted in a rise of rectal temperature to 40°C. After discontinuation of exposure, the temperature continued to rise to 41°C, and then dropped. In contrast, discontinuation of infrared exposure resulted in an immediate drop of rectal temperature.

2. In another experiment the response to microwave and infrared energy of the same power density (0.302 watt/cm^2) and half-power diameter (6.35 cm) was determined.

Exposure to microwaves induced a prompt rise of temperature in the subcutaneous tissues of the area suffering the direct exposure. In three minutes, the mean temperature rose from 37.4° to 45°C. The mean rectal temperature rose to 43.5° in 15 minutes. All animals died. Exposure to the same power density of infrared induced a fairly acute onset, but then a more gradual rise of lumbar subcutaneous temperature. The rectal temperature rose gradually to 43.5°C over a period of two hours, causing the death of these animals (Fig. 18).

3. In this study, 40 rats (prone position) were again exposed to the same power density (0.30 watt/cm^2) and half-power diameter (6.4 cm), but in half of the animals the fur was closely clipped before exposure to microwaves and infrared.

The results demonstrated, again, a difference in response to these two forms of energy. Rats (controls) exposed to microwaves died in 15.5 minutes (13 to 19 minutes). Those without fur died in 18.5 minutes (15 to 25 minutes). The presence of fur had no influence on minimizing, absorbing, shielding, or insulating the animals from microwaves, indicating that rat's

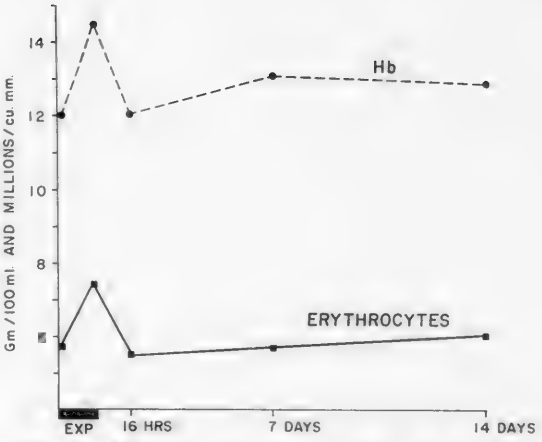

Fig. 15—Effect of microwaves (radar) on erythrocytes and hemoglobin in the rat (prone position; lumbar area [7.0 cm diameter]; power density 0.024 watts/cm^2; continuous seven and one-half hours' exposure).

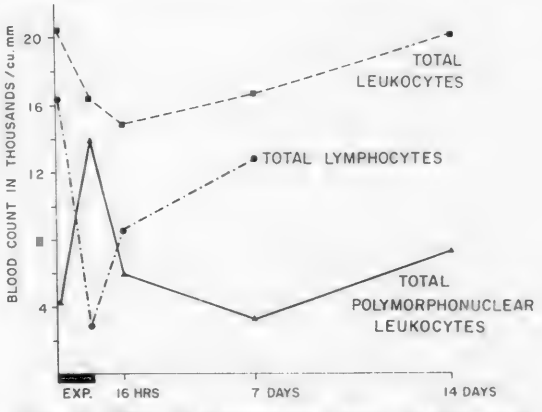

Fig. 16—Effect of microwaves (radar) on leukocytes in the rat (prone position; lumbar area [7.0 cm diameter]; power density 0.024 watts/cm^2; continuous seven and one-half hours' exposure).

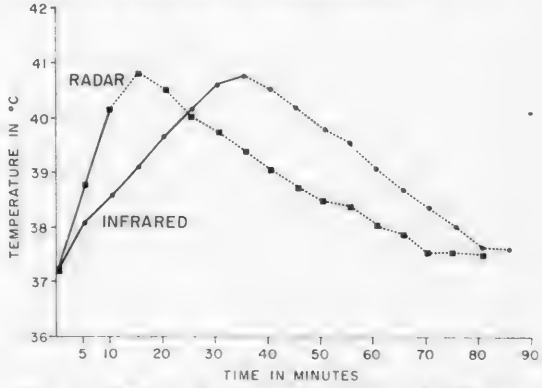

Fig. 17—Effects of microwaves (radar) 0.170 watts /cm^2 and infrared energy (0.270 watts/cm^2) on rectal temperature of the rat (prone position; radar exposure 10 minutes; infrared exposure 35 minutes; lumbar area [8.6 cm diameter]).

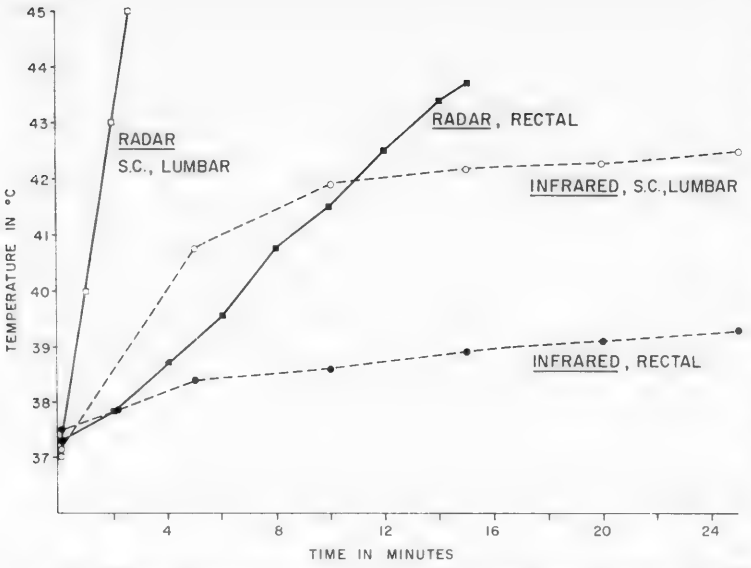

Fig. 18—Effect of microwaves and infrared at same power density (0.302 watts/cm²) on rectal and subcutaneous temperatures of the rat (prone position; exposure of lumbar area [diameter 6.35 cm]; three rats in each group).

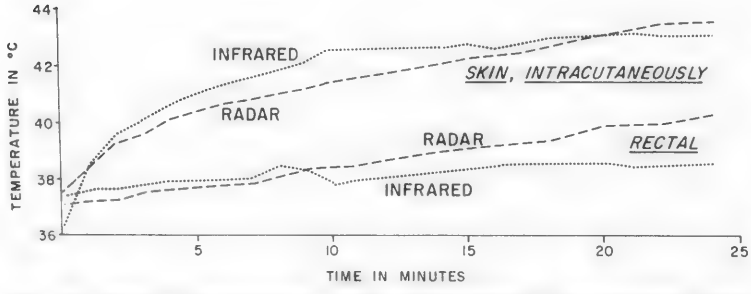

Fig. 19—Effect of microwaves (radar) 0.043 watts/cm² and infrared lamp 0.117 watts/cm² on temperature in the rat (prone position; continuous exposure of total body).

fur offers no barrier to electromagnetic radiation in this range. However, the absence of fur apparently allowed better heat dissipation and, consequently, a prolonged survival time. When exposed to infrared, the presence of fur presented a protective barrier. The animals survived for 120 minutes (70 to 175 minutes), while those without fur died in 48 minutes (44 to 52 minutes).

4. In a fourth experiment, an attempt was made to determine the power density of microwave and infrared energy which would induce a similar degree of hyperpyrexia. Rats, restrained in the prone position, were exposed individually to microwaves at a power density of 0.043 watts /cm². Rectal and intracutaneous temperatures (lumbar region) were determined with the thermistor probes. Other rats were exposed similarly, but to infrared energy. The location of the infrared lamp was varied until a position was found which induced essentially the same rise in temperature as produced by microwaves. At this specific distance the calculated power density of infrared was found to be 0.117 watt/cm². Figure 19 presents the data summarized from two groups of three rats. They show that, as far as the production of hyperpyrexia is concerned, microwaves are at least three times as potent as infrared energy.

Repeated Exposures

A. *Effects in Chicks*—During early studies, one of four chicks demonstrated staggering and partial collapse when it passed through the center of the radar beam. The following experiments were conducted to test the reproducibility of this observation.

Four 10-day bantam chicks (Group 1) were exposed together to 0.017 watt/cm² (half-power diameter 27 cm at floor of Plexiglas chamber) five hours per day on each of 10 days over a total period of 12 days. Another group (Group 2) of four chicks was exposed on 10 days to 0.027 watts/cm² (half-power diameter 21 cm). A third group of four chicks was maintained under similar conditions (Plexiglas chamber, etc.), but the birds were not exposed to microwaves.

The effects noted in the two experimental groups were the same. When passing through the center of the beam, a chick would stagger and demonstrate muscular flaccidity or collapse. This occurred immediately after the start of exposure. Equilibrium was apparently not affected, since a bird maintained its balance even though it could not stand. Tonic or clonic spasms of legs and wings were noted occasionally, lasting each time for a few seconds. Recovery occurred in 5 to 15 minutes while the exposure continued. A chick would rise suddenly and walk to the peripheral area. During subsequent exposures, the chicks avoided the central area of the beam. The 10 five-hour periods of exposure induced no gross pathological changes.

On several occasions, a five-hour period of exposure was interrupted and the birds were

Table III—Lethal Exposure Time for Rats Exposed Intermittently

Type of Exposure	Severity of Exposure in Relation to Control Exposure, Minutes	Mean Lethal Period of Exposure, Per Cent	Maximum Rectal Temperature °C
Control:			
Continuous exposure	100	15.5	43
Exposure 1 minute, nonexposure 1 minute, etc.	50	16.5	43
Exposure 1 minute, nonexposure 5 minutes, etc.	17	34.0	42
Exposure 1 minute, nonexposure 6 minutes, etc.	14	49.0*	40.5
Exposure 1 minute, nonexposure 7 minutes, etc.	12.5	Survived	39.3
Exposure 1 minute, nonexposure 10 minutes, etc.	9	Survived	39
Exposure 1 minute, nonexposure 12 minutes, etc.	8	Survived	38.5
Exposure 1 minute, nonexposure 14 minutes, etc.	7	Survived	37.5

Power density 0.302 watts/cm², exposure of lumbar region; there were four rats per group.

*Only one animal of this group died; its rectal temperature rose to 42°C.

permitted access to food and water. All chicks exposed to microwaves sought water first, then food, while the control chicks looked for food first, then water. Dehydration, as a result of the heating effect of microwaves, is believed to be the reason for the thirst of the experimental chicks.

B. Effects in Rats—Since continuous exposure of sufficient power density will kill rats and mice, experiments were conducted to determine possible effects of intermittent exposures.

A rat was restrained in the Saran screen holder and its lumbar region was exposed to a power density of 0.30 watt/cm². A one-minute period of exposure was followed by a nonexposure period of 1, 5, 6, 7, 10, 12, or 14 minute duration, respectively. This intermittent type of exposure was carried out for a maximum of 65 minutes of actual exposure (Table III).

Several important observations were made. Continuous (control) exposure to 0.30 watt /cm² killed all rats in 15.5 ± 2 minutes, while interrupting the current so that the microwave generator was *on* one minute and *off* one minute (50% of the control dose of microwave energy per unit of time) killed the animals almost as rapidly, namely, in 16.5 ± 2 minutes. Seventeen per cent of the "control" exposure (1 minute *on*, 5 minutes *off*) doubled the period of survival. Rats died in about 34 minutes. One rat died (in 49 minutes) when the one minute exposure period was interrupted by six minutes of nonexposure. The other three rats of this group survived 65 minutes of actual exposure. A rise in rectal temperature was noted in all experiments, except in the last, in which the exposure was interrupted by 14 minutes of nonexposure (Fig. 20).

Another significant observation was that all exposures above a certain minimum in intensity (1 minute *on*, 12 minutes *off*) induced, for a period of five minutes, a sharp rise of rectal temperature, that is, from 37.5° to 39° or 39.5° C. At this point the temperature either continued to rise, when the exposure was severe, or it levelled off, to rise again somewhat later, in the instances in which the exposure was moderately severe (17 and 14% of control exposure). From these data, it becomes apparent that the rat can compensate quite well for microwave-induced hyperpyrexia as long as the exposure is not severe enough to raise the rectal temperature above 39° or 39.5°C.

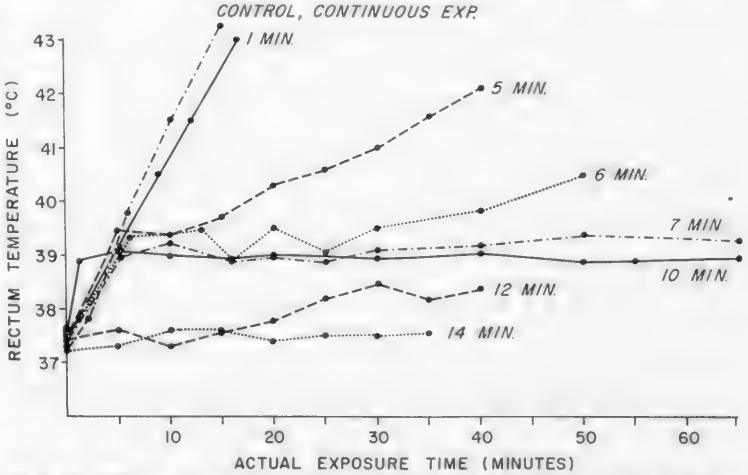

Fig. 20—Effects of intermittent exposure to microwaves on the rectal temperature of the rat (prone position; exposure of lumbar area; 0.302 watts /cm²; four rats in each group; all exposures limited to a period of 1 minute followed by a nonexposure period of 1 to 14 minutes; curves identified by "minutes" of nonexposure).

Summary

Experimental animals (rats, mice, chicks) were exposed to microwave energy, emitted by a pulsed magnetron with a frequency of 24,000 megacycles (wavelength 1.25 cm). The studies conducted have shown the following facts:

1. There is an inverse relationship between power density and lethal exposure time (rat and mouse, prone position, total body exposure).

For the following power densities, the minimum lethal exposure periods were as follows: 0.15: rats 35 minutes, mice 5 minutes; 0.08: rats 56 minutes, mice 13 minutes; 0.05: rats 80 minutes, mice 35 minutes; 0.03: rats 135 minutes, mice 140 minutes.

Within the limits of these experiments, the survival time of microwave exposure increased with an increase in body weight of the rat.

2. The signs of microwave intoxication depend on the severity of exposure (power density and time) and on the site of the body irradiated. Exposure of the head (rat) in the near-field induced central nervous system stimulation (no convulsions) alternating with periods of depression. Rats were immediately aware of the beam and tried to move the head to avoid it, there was squealing and struggling. Exposure of the lumbar or abdominal area of the rat, or total body exposure of the rat and mouse, did not induce signs of central stimulation. A rise in body temperature was commonly observed. As a rule, rats and mice died when their rectal temperature reached 43°C. During the first and the second period of exposure to the central area of the radar beam, a chick would stagger and demonstrate muscular weakness or collapse and, occasionally, tonic or clonic spasms of legs and wings. Recovery occurred in 5 to 15 minutes while the exposure continued. During subsequent exposures, a chick avoided the central area of the beam.

3. The local effects produced in the rat were in relation to the severity of exposure and ranged from hyperemia to first, second, or third degree burns. After a severe exposure (in the near-field for 10 minutes), the muscular layers were light gray in color and had a "cooked" appearance. Total body exposure (rat) resulted in severe hyperemia and diffuse hemorrhages in the subcutaneous tissues and mesentery. The pathological changes were particularly marked in the region suffering the most direct exposure. Moderate congestion of the lungs and slight discoloration of liver and spleen were still noted after a three-hour exposure to 0.03 watt/cm^2.

4. Different regions of the body demonstrated significant differences in susceptibility. Exposure (0.30 watt/cm^2) of the abdomen of a rat required the shortest time to kill, namely 12.3 minutes. Exposure of the head required 18.5 minutes for the production of fatalities, while the lumbar region took an intermediate position (15.5 minutes).

5. Following total body exposure (rat, prone position) hyperpyrexia was most acute in the area suffering the direct exposure, second to respond of the areas tested were the subcutaneous tissues of the abdominal area; third, the subcutaneous tissues of the back outside the half-power diameter; and, last, the rectal temperature. In an anesthetized rat placed on its right side, the abdominal organs responded with hyperpyrexia in the following order: stomach, spleen, kidney, and liver. Microwaves apparently penetrate bony structures. Exposure to as little as 0.02 watt/cm^2 induced a mild hyperpyrexia at the dural surface below the frontal portion of the rat's skull. Exposure of the scrotal area (rat, supine position) resulted, as may be expected, in a higher temperature in the subcutaneous tissues than in the testicle.

6. Comparison of the local changes induced by microwaves and infrared of similar power density (0.5 watt/cm^2) demonstrated that infrared effects were confined to the skin, while the effects of microwave energy involved the muscular layers to a depth of 5 to 8 mm.

7. Comparison of the systemic effects produced by microwaves and infrared of similar power density, in rats with fur and others from which the fur had been removed by clipping, demonstrated that fur did not inhibit the penetration of microwaves, while it markedly protected rats exposed to infrared energy.

8. Hyperpyrexia induced by microwaves increased in intensity after termination of exposure to 0.2 to 0.3 watt/cm^2. In contrast, the rectal temperature of the rat dropped immediately upon cessation of infrared exposure of similar intensity.

9. When measured rectally or intracutaneously, microwave energy, in terms of watts/cm^2, is approximately three or more times as potent as infrared energy in causing hyperpyrexia.

10. Intermittent exposures to microwaves, more than continuous exposure, emphasize the prolonged action of this energy. When compared with continuous exposure (0.30 watt/cm^2), which killed a rat in 15 minutes, intermittent exposure to 50% of this energy per unit of time over a period of 31 minutes (generator 1 minute *on*, 1 minute *off*) killed in 16 minutes of actual exposure time, while 17% of the above microwave energy (1 minute *on*, 5 minutes *off*) killed in 34 minutes of actual exposure. These studies suggest that microwave energy might induce subacute or chronic effects if for no other reason than because of prolonged mild hyperpyrexia.

Conclusions

Acute exposure to microwave energy with a frequency of 24,000 megacycles (wavelength of 1.25 cm) is capable of inducing marked local and systemic effects in rats, mice and chicks and death in rats and mice.

In view of the fact that a power density of 0.01 watts/cm^2 is generally considered safe for repeated human exposures, it should be noted that 45 minutes of exposure (rat) to 0.02 watt/cm^2 induced slight congestion of the lungs, a subcutaneous scrotal tissue temperature of 35°C, and a rise in temperature of 1°C at the dura of the frontal lobe of an intact skull. Seven hours of exposure (rat) to 0.024 watt/cm^2 caused a marked leukocytopenia and an increase in the number of erythrocytes per cubic millimeter.

Unquestionably, man, because of his size and body weight, is much more resistant to the effects of microwaves of this frequency than small laboratory animals, but the fact remains that local injury may occur if the exposure should be sufficiently intense and prolonged.

Comparison of effects produced by microwaves and infrared energy of similar power density revealed distinct differences. This finding suggests that the conclusion reached by Schwann that microwaves above 3,000 megacycles, from a practical point of view, are comparable with infrared in their effects on mankind, needs some modification at least as far as 24,000 megacycles is concerned.

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Acknowledgment

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References

1. Ginzton, E. L.: Microwaves, *Science* 127:841, 1958.
2. Terman, F. E., and Pettit, J. M.: *Electronic Measurements*, New York, McGraw-Hill Book Co., Inc., 1952, p. 438.
3. *Microwave Equipment Catalogue C3*, DeMornay-Bonardi Corporation, New York, 1957.
4. Elfring, G.: Effects of the Local Application of Heat on the Physiology of the Testes: An Experimental Study on Rats, Helsinki, Finland, Department of Physiology, Veterinary College of Helsinki, 1950.
5. Schwann, H. P.: Survey of Microwave Absorption Characteristics of Body Tissues. Proceedings Second Tri-Service Conference on Biological Effects of Microwave Energy, Rome, N. Y., July, 1958, p. 126.

United Air Lines Host to Industrial Health Committee

Shown here are members of the Industrial Health Committee of the Colorado State Medical Society, gathered in Denver for its annual symposium on May 8. A feature of this year's meeting was a special luncheon served aboard a DC7 when the committee members were guests of United Airlines and its Medical Director, Louis C. Benesh, M.D., who is IMA District Counselor for Colorado.

Preparation for Retirement

Frederick H. Shillito, M.D., Ann Arbor, Michigan

THE LIFE SPAN may be divided conveniently into three parts: (1) preparation and training, (2) productive years of employment, and (3) retirement. This third phase is rapidly gaining ground on the other two in importance and magnitude. Industry has contributed very largely to formalizing the "retirement" years. In this country a pension fund was started in 1875 by the American Express Company. This company generally is credited with being the first to take this step.[1] Others followed the lead, and by 1930, 80% of railroad employees and about 90% of employees in the communications field were benefited by a pension plan. Obviously, such programs were developed first in the older and more mature industries. In general manufacturing, for instance, not more than 15% of employees were covered by 1930. Since then, benefits and coverage have been extended over a large part of the industrial population of the United States. Management, government, and employee groups have given impetus to this growth.

It is interesting that the age of 65 years has been so generally selected as a time of retirement. In the early days of railroads, management undoubtedly was concerned with loss of efficiency and safety hazards of the older employee. The age of 65 has been crystallized further by Social Security benefits, which, for the male, apply generally at the age of 65. It is only recently that a change in this established age has been made for the female, with retirement age set several years below that of the male. In case of Social Security, unfortunately, a premium is placed upon a man of 65 withdrawing from employment. In fact, benefits are withdrawn if his earnings are over a figure of approximately $1,200 per year. This loss of potential productive capacity is being recognized as a disadvantage of Social Security and in the last Congress, some changes were made so that a man of 65 has somewhat more latitude in accepting gainful employment without losing Social Security benefits.

Fifty years ago, 1 man in 25 in our population was over 65. Now, 1 in 13 in our population is over 65 years of age.[2] With mandatory retirement for all at the age of 65, this would mean that over 12,000,000 persons in the United States would be frozen into inactivity. Ignoring for a moment the humane aspects of the problem, the situation is of concern to our government because of the loss of production and the load thrown upon younger people to carry the burden. So, attention is being turned to the problems of the third estate—our senior citizens. In the last Congress the President was empowered to summon a White House Conference on the problems of aging.[3] The objectives of this conference, which is to be preceded by nationwide conferences by leaders in cities and states, is to determine ways to utilize the skills of older people and to improve their condition of living. Obviously there is thought of a turn away from inflexible mandatory retirement at the age of 65 toward the ideal proposition of utilizing the entire work force in the nation regardless of age. Only the unemployables would be idle. It is highly doubtful, however, that such a solution can be achieved rapidly. So the problems of retirement at the age of 65 are with us now and must be solved. Two out of three potential retirees are apprehensive and concerned about being retired.[4] They turn to their superiors, to their friends, and to their physicians for advice. In a questionnaire study on retired ministers and widows, Hibbard and Lee found that about 25% of the group had actually sought out their physicians for advice. The physicians in this audience who are with industry must appreciate how much the man who is facing retirement can be helped. In passing, one cannot help but comment that it is best if

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TABLE I—SURVIVAL RATIO BY AGE AND FIVE-YEAR PERIOD OF RETIREMENT

Age of Retirement	Army Officers	U.S. White Males
50-54	88.6	92.2
55-59	82.3	88.7
60-64	86.2	83.9

From McMahan and Ford.[5]

the physician has retirement plans of his own. "Physician heal thyself."

The difficulties of the years of retirement are indeed very well known. Loneliness and unhappiness are complained of so frequently that their existence is self-evident. Such disappointment and heartbreak is said to shorten one's life. Elucidation of this statement has been presented by McMahan and Ford[5] (Table I). These figures were compiled on retired officers. It can be seen that for five years after retiring at the age of 65, the Air Force officers have a survival ratio which is higher than for comparable U. S. males. At lower ages, there is a lower survival ratio—undoubtedly due to the fact that early retirements are based many times on physical disability. The medical cause for retirements, so frequently cardiovascular, causes an increase in the death rate during the first five years of retirement. Other tabulations seem to substantiate the figures on the high survival rate after retirement. Records of the American Can Company show that over the last 20 years, 1,455 employees were retired under the annuity plan. Of these, 1,048 (72%) are still alive in 1958 and receiving annuity payments.

Even if such figures indicate a favorable survival rate of retired men, there still is reason for close attention to the problem. The psychological strains produce depression and melancholia. So it becomes one of the leading disease states, as far as morbidity is concerned. We cannot afford to ignore it.

Flexible Retirement

The concept of determining an individual's retirement age solely on a basis of physiological age is most appealing.[6] This idea acknowledges the differences between one and another employee in physical, emotional, and mental health and in ability to perform useful work. Chronological age would be ignored and a man would continue to work as long as feasible. This statement should not be interpreted as extending retirement age beyond 65, 68, or 70 years for every industrial worker or even for a needy case where mandatory retirement poses severe economic strain and hardship. Flexible retirement age would be established in the low fifties (premature senility) for some and up to 70 or more for others. The great majority would fall between 60 and 70. This audience does not have to be reminded that work and production for most individuals do decrease as the decades roll along. For one thing, the older individual, while absent less frequently, suffers illnesses of longer duration[7] (Table II).

TABLE II—EFFECT OF AGE UPON SICKNESS ABSENTEEISM

Age	Average No. Absences per Employee	Average Days per Absence
30-39	1.1	5.9
40-49	0.9	8.8
50-59	0.8	14.8
60-65	0.7	25.8

From L. Wade.[7]

TABLE III—MEDICAL REASONS FOR PREMATURE RETIREMENT

Cardiovascular disease	71%
Psychoneurosis	6%
Neoplastic diseases	4%
Arthritis	4%
Other	15%
	100%

From L. Wade.[7]

In a plan of flexible retirement, appraisals would be made periodically either on special cases or routinely from the age of 50 onward. Industrial physicians know of the increased incidence in these years of cardiovascular disease, including arteriosclerosis, peripheral vascular disease and hypertension; of obesity; of diabetes, of prostatism, and of neoplastic diseases including cutaneous epitheliomas (Table III).

Psychological appraisal would have to be considered in a flexible retirement plan. Bennett[8] states that on psychological testing, a man scoring a mean of 50 (half of his group scoring above him and half below) in his twenties will decline steadily as the years roll along. But the other members of his age group are also deteriorating. There is no gainsaying, however, that he suffers in comparison with younger men and with his own score made in his twenties (a mean of 50), which will sink to 17% in later years. True, experience and maturity may make up for the deterioration. This consideration brings us to the final appraisal. In a plan of flexible age retirement, the actual performance of the man at his job would have to be appraised. Usually such appraisals are made by older men upon their juniors, but in flexible retirement it would by

necessity often be the other way around. The difficulties of the plan of a flexible age retirement program are fraught with such problems and there are so few specialists qualified to do various appraisals that recourse is usually made to mandatory age retirement—and the chips fall where they may.

Decreased Work Load

Another very appealing concept is offering the older man (categorically 65 or more) a new job where he can take it easy. Administratively, this often becomes a nightmare. For one thing, there is a reluctance by the individual to accept less money than he previously earned. Too high a rate of pay is suggested for the particular work performed, a situation which is not compatible with a company maintaining itself in a fiercely competitive business climate. Other roadblocks to wide application of decreased work load for the older man are seniority (impeding the rise of younger men), Social Security benefits (lost if earnings over $1,200 annually, etc.), and difficulty for the individual adjusting himself to a new job with less prestige and recognition.

Occasionally, a company can develop a plan which will allow persons past the age of 65 to be assigned tasks which are within the capacity of the older individual and yet are so important that the earnings can be substantial. In the American Can Company a very happy adjustment has been possible, at least for some older men, beneficial both to retired personnel and to the corporation. The knowledge and experience of older men is used in foreign service. Such individuals serve in a program of supplying know-how for the establishment of modern plants in other countries. This is no job for a novice or for a man of a few years' experience. Many years of intimate association with the manufacturing operations are necessary before a man is qualified to be sent out to help set up the plant in foreign service. The older man is also an ideal choice because his family is grown and the obstacle of school problems does not exist in assignment in a foreign country. Almost everyone facing retirement hopes to travel, and there is no lack of such in this program. Being of a consultative nature, much of the strain of his previous industrial life is removed. Finally, the work is constructive and remuneration is adequate.

It is my personal conviction that a retiree should be allowed to work at jobs less remunerative than those he previously held. If these earnings could be supplemented by his company or private insurance annuities, and if he was not penalized by cancellation of his Social Security benefits, a pretty ideal situation would exist. The labor force would be greatly expanded by useful work being done by persons over 65, and the persons concerned would be receiving each month (in most cases at least) as much money as they were at the time of formal retirement, or more. Perhaps the President's Conference of 1961 will consider such matters. Likewise, the Senate Welfare Committee, in its study on problems of the aged with greater emphasis on greater utilization of the skills of retired people, will have to give this type of plan some serious thought. It will mean concessions by many groups, but such cooperation will be necessary to solve a critical situation.

Individual Preparation for Mandatory Retirement

It is very well to philosophize on changes in the future for the retired individual. The immediate problem, however, is to deal with the present-day situation where retirement so frequently is mandatory at the age of about 65 years. Retirement, with its many advantages and some difficulties, is not a matter concerning only a small segment of the employee group of a company. Rather, it is a matter which will involve almost every employee sooner or later.

A great service can be done by helping the individual adjust to the realism of retirement before the day arrives. The time to make one's plans for his years of retirement is not after the gold watch has been passed out, the speeches have been made, and the retiree has been set down on the beach. It is never too early to make plans. The individual who today, in his younger years, is self-reliant, enthusiastic, and enjoying life will have little trouble in his years of retirement. Such a man is eager to turn his energies into new activities. He lives his life so fully and eagerly that one project after another is piling up waiting for leisure time when attention can be turned toward them. Ross[9] has written an essay in the *Journal of the American Medical Association* about the inevitable years of retirement which lie ahead for the physician. This work could be read to good advantage by practicing physicians of all ages. He stresses that the busy physician who devotes himself solely to his profession and excludes other factors, which contribute to creating a full life, is ill equipped for retirement.

In order to be content in the third phase of the life cycle, i.e., years of retirement, a man should be secure economically, enjoy the best health that is possible, live in a community which he likes and enjoys, be busy and active,

and finally, be fully adjusted to his station in society. A program of preretirement indoctrination should help the individual to develop each of these basic elements.

Economic—As stated early in this paper, companies with their pension plans have made great strides toward helping a retiree achieve a considerable degree of economic security. Except to say again that I personally feel a man over 65 should be allowed to earn as much money as he can without being deprived of annuities and social security, I have nothing to add to this phase of retirement planning, which can be done so much more capably by financial experts.

Health—A periodic health examination program[10] is particularly essential in the last few years of a man's industrial life, i.e., from 55 or 60 until the time of retirement. Significant changes occur more rapidly in the fifth and sixth decades of life than in earlier years. Perhaps of even more importance, however, is that many middle-aged individuals jeopardize their future health by succumbing to the attractions of a soft easy life. The periodic health examination is an ideal occasion for the industrial physician to give wise counsel in regard to healthy daily living. A vast field in preventive medicine is yet to be explored in evaluation of daily exercise, strict weight control, proper nutrition with special regard to variable elements such as fats, minerals, and additives, moderation in tobacco and alcohol, and the attainment of equanimity.

Geographic—Generally speaking, an older person is happier among established associations and old friends than if he uproots himself for a move to a milder climate. While it is pleasant to consider a new life and new surroundings, these advantages often are overtaken by difficulties in adjustment necessary in such a move. For some, a move to a new locale at the time of retirement is both feasible and beneficial. Often these cases are persons who have relatives or friends in the new location or who have resided previously and owned property in the area. For others leaving old friends and fond associations for a strange environment is ill advised. Without well-laid plans and much thought, uprooting one's self at the time of retirement is extremely hazardous.

Activities—It is necessary that plans be made for an active life after retirement. Employees being counseled in retirement plans should be encouraged to take adult education courses. The Mott Foundation,[11] Flint, Mich., for example, is active in offering such courses (Table IV). This Table shows only a partial list of subjects and courses available. Mastering al-

TABLE IV—MOTT FOUNDATION PROGRAM—EDUCATIONAL

Successful selling	Photography
Income tax returns	Leathercraft
Creative writing	Dresden craft
Bookkeeping	Carving cowhide
Landscaping	Creative ceramics
Household mechanics	Art workshop
Furniture refinishing	Water color painting
Furniture upholstering	Oil painting
Woodworking	Lettering and sign painting
Chair caning	Knitting
Wood carving	Dressmaking
Radio repair	Tailoring
Auto shop	Millinery
Lampshades	Furs
Television	Slip covers and draperies

From Woughter.[11]

most any one of these skills could lead to a vocation or hobby after retirement. Let me stress again, however, that these preparations should not be postponed. Enroll in a course, be it at a classroom or by television, right now.

Philosophic—This phase of preparation is probably the most important factor that is to be mentioned. Right now, for persons in every age group, and especially so for persons facing retirement in 5 to 10 years, the importance of a positive cheerful life philosophy should be appreciated as a means to avoid querulousness, quarrelsomeness, impatience, loneliness, and depression after retirement. Individuals should strive to live in that happy state that Osler defined as equanimity. Another physician[12] more recently has rationalized on the somatic effects of excesses in emotions such as guilt, rage, jealousy, and a sense of inferiority. With the complexity of modern life increasing, never before has it been so important for the individual to achieve a positive philosophy through religion or other means. The industrial physician, relying on the warm relationship of physician and patient, can stress the importance of emotional life. Practically speaking this must encourage the individual to seek enlightenment and equanimity through wise choice of friends and books—and, finally, and by no means the least important, religion and faith. So this is another task for the industrial physician—and not such an impossible one as it might appear. In this hectic, high speed and neurosis-producing existence, the individual is pretty receptive to advice which will help him achieve personal contentment and equanimity—and, incidentally, prepare him for the years of retirement.

Summary

Mandatory retirement at the age of 65, if applicable to the entire population of the United States, would mean twelve million peo-

ple frozen into inactivity. The loss of production and the load upon younger people in such an event would be a deterrent to our national progress. The ideal alternative is to develop flexible retirement plans. Physiological rather than chronological age would become the sole basis of retirement. The industrial physician would be faced with very difficult and crucial decisions as to the physical status and work capacity of all members of the industrial population. Even more vexing than the determination of physical disability would be the rating of mental ability. In fact the difficulties of a flexible retirement program are so great that it is very doubtful that it can be put into anything like universal practice in the foreseeable future. A few sensible modifications of retirement plans and Social Security benefits, however, would allow the older worker to turn to less exacting and difficult jobs. Thus, he would continue to be productive. His actual earnings would be less, of course, than the amount he was receiving at the time of "retirement." These decreased earnings, however, hopefully might be augmented by retirement benefits.

With mandatory retirement at the age of 65, which is the usual plan at the present time, individuals are forced to make major adjustments. It is never too early to make plans. The individual who in his younger years is self-reliant, enthusiastic and enjoying life will have little trouble in his years of retirement. The locality where the retired worker decides to live is an important matter. There are important health and economic factors. Hobbies and activities for the latter years must be developed. It is never too early to start to prepare for retirement. Suggestions towards ways and means of doing so are outlined in this paper.

Bibliography

1. Dearing, C. L.: Industrial Pensions, Washington, D. C., The Brookings Institute, 1954.
2. Elliott, C. K.: Why, Where, When and How to Retire, *Nebraska State M. J.* 40:231-236 (July) 1955.
3. Washington D. C. Special Report, 85-12, American Medical Association.
4. Hibbard, D. L., and Lee, J. P.: Presbyterian Ministers and Their Widows in Retirement, *J. Geront.* 9:45-55 (Jan.) 1954.
5. McMahan, C. A., and Ford, T. R.: Surviving the First Five Years of Retirement, *J. Geront.* 10:212-215, 1955.
6. Mathiason, G.: Flexible Retirement, New York, G. P. Putnam's Sons, 1957, pp. 226.
7. Wade, L.: Medical Preparation for Retirement, *Indust. Med. & Surg.* 22:214-218 (May) 1953.
8. Bennett, G. K.: Psychologists View of Retirement Problems, *Indust. Med. & Surg.* 23:209-212 (May) 1954.
9. Ross, S. S.: The Physician and Retirement, *J.A.M.A.* 156:1106-1107 (Nov.) 1954.
10. Shillito, F. H.: Periodic Health Examinations, *Ann. Int. Med.* Vol. 39, No. 1 (July) 1953.
11. Woughter, H. W.: Plan for Living in Retired Years, *Michigan M. J.* 52:513-15 (May) 1953.
12. Schindler, J. A.: How to Live 365 Days a Year, Englewood Cliffs, N. J., *Prentice Hall*, p. 222.

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Some Practical Aspects of Disability Evaluation

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ANYONE who has dealt with disability evaluations has an acute awareness of certain fundamental deliberations which will become guidelines in decision-making. Among these are definitions of terms; legal considerations; the true purpose of the disability appraisal; anatomical, psychological, functional, and sociological factors; hard-core versus extraneous factors; and sometimes unanticipated miscellaneous influences bearing on exceptional cases.

At the outset let it be said that overriding considerations in disability appraisals are the individuality and motivation of man. "Nothing succeeds like success." There is no substitute for earning capacity. Such capacity is and always will be influenced by skills, decisions of character, and the thing called "will power." As pointed out by the American Medical Association's Committee on Medical Rating of Physical Impairment,[1] "permanent impairment is a contributing factor to, but not necessarily an indication of, the extent of a patient's permanent disability." It is sometimes forgotten, or is an example of improper definition, that disability is not a purely medical condition. It is a state or condition arising out of an impairment which renders a person unable to engage in gainful activity. Perforce the evaluation (rating) of a disability is ultimately "an administrative, not medical, responsibility and function." Even when a physician is requested to participate with or serve as the administrator in rating disability, he must keep the definitions clear and continually remember his assigned function, be it a single or dual role. Nonmedical factors, such as age, sex, education, and economic and social environment, must be considered along with the medical impairment in the ultimate evaluation of disability. Such factors may have little or great relative weight, but they cannot be ignored.

The legal impact on the meaning of disability became apparent soon after the adoption of workmen's compensation statutes, starting nearly 50 years ago. Recently Waters[2] described three distinct concepts of the term "disability" recognized in different states in adjudicating compensation claims: "1. Inability to earn full wages. 2. Total inability to perform any other work. 3. Actual incapacity of an employee for performance of his work in the last occupation in which he was engaged."

These concepts are similar in that benefits are based on loss of capacity to function in a work setting. This orientation becomes tenuous or is lost entirely, however, in compensation practices which provide indemnification for pain, for loss of physical integrity, or for anatomical residues of recovery which in no way affect physiologic function.

There is also important legal influence on the definition of disability in the provisions of Public Law 761, 83rd Congress, Public Law 880, 84th Congress, and Public Law 840, 85th Congress. These amendments to the Social Security Act affect the large group of people who may seek disability determinations through state agencies for the Bureau of Old-Age and Survivors Insurance, of the Social Security Administration. For this purpose "disability" means "(A) inability to engage in any substantial gainful activity by reason of any medically determinable physical or mental impairment which can be expected to result in death or to be of long-continued and indefinite duration, or (B) blindness; the term 'blindness' means central visual acuity of 5/200 or less in

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the better eye with the use of a correcting lens."[3] Definition "B" thus is an example of a statutory declaration of disability (for purposes of the disability "freeze").

The meaning of disability under definition "A" unavoidably introduces an exercise in semantics. What constitutes "substantial gainful activity"? When is an impairment "medically determinable" and when does the evidence of impairment become so elusive that it can be said to be not medically determinable? For example, pain is a problem in adjudication when it is the chief alleged disabling factor. There is no objective measure of pain. Pain is a response that has no quantitative relationship to the character or quality of the stimulus. Sometimes a correct diagnosis is based on little more than the intuition of an astute physician.

An impairment may result in death for one patient and not for another. A disease expected to result in death this year may be expected, as a result of scientific progress, to be curable next year. What degree of risk (hazard of therapy) must a man assume for himself in an effort to avoid death or correct a remediable condition? What constitutes "long-continued and indefinite duration"? With the provision of a six-month waiting period in the Social Security Act, this phrase arbitrarily can be taken to mean that the medical impairment has been present at least six months, at the end of which time there is no foreseeable recovery.

Differing levels or degrees of disability unquestionably enter into the determination of pensions. These arise from differing disability pension plans and from the changing purposes of disability appraisals. Private industrial groups may accept as qualifying an impairment which prevents the worker, who has accumulated an agreed number of years of service, from continuing in his customary job. This is particularly likely to be true if there is not another job available in the plant suitable for the impaired worker. A laborer who is no longer able to do a given type of labor and who has no special skills to enable him to engage in substantial, gainful activity elsewhere in *that plant* may have his disability appraised as qualifying for a pension even though he is quite able to perform adequately in other types of labor to be found elsewhere. He may cross the street and go to work for a new employer with the knowledge and blessings of his former employer who is paying him a disability pension.

The disability determination in such an instance is based on the significance of the medical impairment as it relates to his customary work and to any other job opening the first employer can provide. The smaller the plant and the less diversified the operations, the fewer will be the opportunities to place a handicapped worker. A trend toward liberality in this situation would seem to be influenced by the social consciousness of employers, interest in rewarding long service, public opinion, and other nonmedical factors.

An insurance policy written to protect the worker against permanent loss of earning power might be planned to become effective only if the worker considered in the preceding illustration were incapacitated for substantial earnings in all types of labor within the community or geographic area. In that event he would not become qualified for the insurance benefits so long as there were suitable jobs open to him in other plants or business enterprises. I know of instances of disability evaluations that led to granting pensions under a company plan and concurrent denials of benefits under a group insurance policy sponsored by the same company. The degrees of disability were interpreted as qualifying for one but not for the other by administrators who were concerned with both plans. Justification for such "lack of consistency for reason" is not hard to find. It is well known that a man with a given impairment may be able to perform under certain working conditions and fail completely in other working situations.

Ratings of disability by private industry, an insurance company, or the Veterans Administration are not automatically applicable to the Social Security program for the reasons that the fundamental purpose of a disability appraisal under Social Security and definitions of disability in its statutes are different.[4] The feasibility of rehabilitation, the existence of combinations of impairments which when considered alone are not disabling, the possession of skills and experience, and the applicant's psychologic adaptability leave considerable scope for the exercise of sound professional and administrative judgment.

Retirement decisions are influenced by hiring and rehiring policies, the age distribution of employe groups, the character of the work required, and the level of business activities. The condition of the labor market affects the retirement rate. In a tight labor market the average age at retirement tends to rise and the number of applicants for pension goes down. When the demand for labor is low, the average age at retirement tends to go down and the number of pension applicants rises. At the present time the average age of applicants for Social Security old-age benefits is 69 years.[5]

What Is Expected of the Physician?

Out of my experience with an industrial disability pension plan the commonest missing element in the pension application is valid evidence of the petitioner's functional capacity or the extent of his incapacity. Physicians are trained to think in terms of diagnosis and treatment. Usually the evidence to support the diagnosis is entirely sufficient. But most diagnoses are not descriptive of the degree of impairment and the relation of the latter to disability. For example, a diagnosis of emphysema, of diabetes mellitus, or of arteriosclerosis says too little. Many able and efficient workers have such conditions. What is the severity of the disease and its impact on performance? Those who make disability appraisals and, in turn, decisions as to granting or disallowing disability pensions need from physicians who have examined the applicant sufficient detail to permit a determination of degree of severity of the man's impairment.

One can be misled through incorrect statements by an applicant regarding his abilities on the job. He may overestimate or underestimate his ability to perform. Those who are responsible for describing the limitations actually arising from the impairments will do well to watch the worker as he undertakes his job.

This experience of firsthand observation is particularly important for the physician who is requested to evaluate a patient having multiple impairments or impairments which do not lend themselves readily to direct measurement by simple tests in the physician's office. Furthermore, the degree of ability for a particular work activity may be inapparent from mere measurements of the physical defect—what is pertinent is a valid measure of the ability or inability to do the job.

It has been my experience that patients who become applicants for a disability rating often have an unjustifiable confidence in the transcript of their old or recent hospital charts as evidence of disability. Such records may contain quite useful information as to acute illness, nature of surgery, diagnosis and therapy, and nothing as to residual function after convalescence.

Former patients may incorrectly conclude, or hope, that a physician who has not seen them in a professional capacity for many years, has sufficient clairvoyance to report on their status without reevaluation. By telephone or or by mail, requests reach a physician authorizing a report from him to some interested party or agency. The physician's knowledge of the patient may be so out of date as to make his report useless; yet he risks accusations of being uncooperative or mercenary if he suggests a proper and current evaluation so that his report can be factual and meaningful.

A common misconception on the part of pension applicants and of physicians is that the physician making a report must himself determine whether disability exists under the terms of the plan. In the Social Security report form this determination is not asked for, nor is it expected. The same is true as regards most private industrial and insurance plans. The physician is entitled to protection from the necessity of making such a decision and risking its inherent jeopardy to his relationship with the patient. A recommended practice is that physicians inform their patients that medical reports describing impairments are to inform others who, in turn, actually will decide the rating. It will save confusion if the patient is reminded that there are at least three standards for industrial disability pensions: "inability to perform any gainful work, inability to perform any job for the company, and inability to perform the regular job with the company."[6]

For reasons given in the preceding discussion, disability determinations for benefits under Social Security introduce still other variables. The applicant should be informed that acceptance of his disability under one plan is no warranty that it will be accepted under another. These differences in acceptance do not rest in the physician's factual report. The medical reports may be identical for the support of applications under two or more benefit plans.

Other practical considerations involve the physician who attempts to help the worker whose impairment threatens his earning capacity. There are patients who through ignorance, fear, superstition, perverseness, or a combination of these will not accept adequate treatment or measures needed for rehabilitation. Such a patient may adopt a fatalistic attitude and through neglect allow progression of his disease to a point where recovery is not possible.

The preservation of economic usefulness, or rehabilitation for its recovery, is thwarted here and there by strong emotional attitudes. The psychologic, sociologic, and now the economic advantages obtainable through illness and disability loom large, albeit on an unconscious level for many patients. Everyone who becomes ill or injured is to some extent, and for a variable period of time, dependent upon others. Most of us strive to recover our health and, in turn, our former independence. But what of the people who have unrequited demands for

love or attention and who find great emotional satisfaction in these rewards of their disablement? What of the inadequate person who is suddenly released by a physical impairment from the previous harassment of the necessity to work, to compete, to take care of his family? He may understandably cling to and magnify his impairment and refuse to part with it. It has given him a peace of mind hitherto unknown, a protection from the unpleasantness of competing, protection from the acceptance of guilt for his feelings of inadequacy. Here is a serious block to rehabilitation and, in turn, a source of continuing confusion in disability evaluation. The physician who is the therapist is understandably frustrated by his inability to reach and to correct the basic cause of his patient's failure to recover.

To one who subscribes to the philosophy, "the world owes me a living," the disability pension is a tangible and impressive verification of the correctness of his philosophy. He soon adds the concept, "Some one has to take care of me for what was done to me in the past."

Summary

The growth of pension plans and the larger number of older workers require of physicians an increasing number of clinical examinations for the evaluation of medically determinable impairments. Such examinations and reports are needed in the administration of benefit programs of the Social Security Administration, of the Veterans Administration, of insurance companies, employers, and of miscellaneous plans which include disability benefits.

Factual information on the nature of the impairment of the pension applicant and its effect on his functional capacity is the obvious core of the medical report. Varying levels of permanent disability are found to be qualifying for differing pension plans. Furthermore, nonmedical factors of age, sex, length of service, education and skills, economic and social environment, and like influences enter into the acceptance or rejection of pension applications. Thus "rating" is ultimately and unavoidably an administrative decision.

Even with a given category of pensions, such as retirement under an industrial disability plan, the standard may be inability to perform any gainful work, or inability to perform any job for the employer, or inability to perform the regular job for the employer. Such variations may confuse both physicians and applicants unless due attention is given to (1) the changeable requirements of the plans and (2) the fact-finding role of the medical examiner, who is not expected to determine whether disability exists under the terms of a plan.

In addition to these potential sources of misunderstanding there are other problems for the applicant and the physician alike. A diagnosis, in itself, may give an incomplete clue to the degree of impairment and its effect on working ability. The evaluation of the impairment needs to be sufficiently complete and up to date as to serve its purpose of supporting a rating or determination. If an impairment can possibly be corrected by medical and surgical procedures, what degree of risk should be accepted by the impaired worker in undergoing the procedures?

The physician undertaking to rehabilitate a disabled worker quite often is thwarted by serious emotional disturbances in the patient which prevent ultimate recovery and satisfactory return to the job. The evaluation of the role of pain, of multiple minor impairments, and of the patient's psychologic adaptability leave considerable scope for the exercise of both medical and administrative judgment.

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References

1. Committee on Medical Rating of Physical Impairment: A Guide to the Evaluation of Permanent Impairment of the Extremities and Back, Special Edition, *J.A.M.A.* (Feb. 15, 1958).

2. Waters, T. C.: Workers' Compensation and the Physician, *Pub. Health Rep.* 72:1053-1059 (Dec.) 1957.

3. Bureau of Old-Age and Survivors Insurance: Disability Insurance State Manual, Appendix A (Sept. 30, 1958).

4. Mork, B. O.: Disability Under Social Security: Medical Evaluation and Decision as to Rehabilitation, *California Med.* 87:256-260 (Oct.) 1957.

5. Hess, A. E., Assistant Director, Bureau of Old-Age and Survivors Insurance, Social Security Administration, Department of Health, Education and Welfare, personal communication to the author.

6. Royes, R. E.: The Reconciliation of Pensions and Social Security Disability Insurance, *A.M.A. Arch. Indust. Health* 17:590-592 (June) 1958.

Occupational Medicine in the Navy

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Introduction

Occupational medicine in the Navy is responsible for the health and psychological welfare of nearly a half-million civilian workers employed by the Navy and Marine Corps at shore stations in the continental area of the United States, in our territories and possessions, at naval facilities in foreign countries, and aboard ships of the Military Sea Transportation Service. By far the largest amount, nearly 90%, of the work is performed at naval industrial establishments in CONUS under management of the various bureaus or offices of the Navy and the Marine Corps.

The Navy's versatile medical system consists of hospitals (both U. S. naval hospitals and station hospitals), dispensaries with authorized beds, sickbays aboard ships, field medical units with mobile forces (U. S. Marines), and outpatient dispensaries without authorized beds.

During fiscal year 1958 the Bureau of Medicine and Surgery operated 125 such "dispensaries without authorized beds," where 468,456 outpatient work "units" were performed for civilian employees of the Navy. More than a million such "units" of medical service were made available last year to military personnel and their dependents, as shown in the table. In addition, such dispensaries also rendered the following ancillary services: 766,577 immunizations, 681,527 partial examinations, and 2,218,725 adjunct services; total 3,666,879. Partial examinations include limited physical examinations and tests, as well as screening examinations and tests. Adjunct services refer to the number of x-ray films exposed, fluoroscopic examinations, and pharmacy and laboratory services—provided for outpatients only.

Outpatient Services for Dispensaries Not Having Authorized Beds Navy, Fiscal Year 1958

	Outpatient Work, Units
Navy and Marine Corps	906,336
Army and Air Force	14,953
Dependents of military personnel	356,714
Other	62,254
Civilian Employees (Navy)	468,456
Total	1,808,707

The Military Sea Transportation Service alone rendered 103,749 outpatient work units to civilian employees of the government aboard naval transport vessels at sea and 11,552 units at selected shore facilities located in Brooklyn, San Francisco, Seattle, Tokyo and Yokohama. These figures from MSTS are not included in the fiscal 1958 total of "outpatient services rendered by dispensaries not having authorized beds."

As defined by the Department of Defense, "outpatient work units" include medical visits, flight physicals, and other complete examinations. Adjunct services, such as x-ray and fluoroscopic examinations and pharmacy and laboratory services are placed in a separate category and are not considered as OPW units (see *Statistics of Navy Medicine*, 15: 8-16 [Jan.] 1959). "With the advances in medical techniques more patients can receive definitive care as Outpatients and accordingly have their only contacts with the Medical Department at dispensaries of this type." Hence, the very large number of dispensary visits, but to the staff and patients these "numbers" represent the front-line medical care of *people* in any way distressed in mind, body, or estate.

In addition, many other functions, such as preventive medicine, industrial hygiene, and safety programs are performed by medical personnel at naval facilities served by the 125

The opinions or assertions contained herein are the private one's of the authors and are not to be construed as reflecting the views of the Navy Department or the naval service at large.

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"dispensaries without authorized beds." For example, the occupational health program seldom makes the headlines but is a vital and continuing contribution of dispensary medicine to the public health of the employee, without which there would be little or no "production."

The purpose of the naval occupational health program is comparable to that of other such programs in industry, namely: (*a*) to increase the efficiency and production of the Navy's civilian employees, (*b*) to assure the employee diagnostic, ameliorative, and curative medical services for occupational illness or injury; (*c*) to provide rehabilitative placement when indicated; (*d*) to make available reasonable and adequate medical "coverage" for nonoccupational conditions (including physical handicaps); and (*e*) to protect the employer (the U. S. Government) from unjust medical claims and losses.

A naval industrial activity is comparable to a large industrial complex in civilian life. Our stockholders are the citizens of the nation who are the recipients of our production. For example, our customers are the various fleets of the Navy, with their components—aircraft carriers, submarines, cruisers, destroyers and smaller surface ships—their ordinance departments, and huge aviation interests with research and development of guided missiles and new weapons-systems. Since the expense of such hardware is almost astronomical, "cost-consciousness" is a must before, during, and after production. And the greatest of all production factors is the cost of human labor. This is true not only in the Navy but also in other forms of industry, whether private or government. A well-organized health program always justifies its cost because a healthy employee is a productive worker.

Medical personnel in naval industrial activities are an integral part of management. As such, they must implement the administrative, productive, and cost aspects of the industrial medical program. Thus, from the administrative viewpoint naval occupational physicians should keep themselves apprised of the personnel practices of management relative to changes in the work-load and attrition of the labor force which influence policies relative to union and public relations. From the production aspect, medical personnel must be aware of the importance of labor efficiency and productive capacity. Both factors require proper placement and protection of personnel, especially when working with new materials or novel processes. Economic pressure demands that the expense of the entire medical program more than pay its own way by virtue of "services rendered."

Organization

The industrial health program throughout the U. S. Government was authorized by Public Law 658 of the 79th Congress, which directed heads of departments and agencies to establish health service programs for the purpose of promoting and maintaining the physical and mental fitness of employees. Section 24(b) of Public Law 604 of the 79th Congress (60 Statute, 853; 5 USC 421e) authorizes the Secretary of the Navy "to make such expenditures as he may deem appropriate for promotion and maintenance of occupational health of personnel of the Naval Establishment."

Under the regulations of the Civil Service Commission certain physical examinations of employees are necessary. Executive Order 4071, of 4 September 1924, directs the heads of departments having medical personnel to make such physical examinations of applicants for, and employees in, the federal competitive service as may be requested by the Civil Service Commission or its authorized representatives.

The purposes of our Occupational Health Program are three: (1) to comply with the U. S. Employees Compensating Act, (2) to serve the employee by assisting him to maintain optimum health while on the job, and (3) to serve the government and the Navy by increasing or maintaining production through establishment and maintenance of optimum health hygiene in the total work environment.

The responsibility for coordinating and integrating the administrative and technical functions of the medical department is vested in the Surgeon General of the Navy, who is Chief of the Bureau of Medicine and Surgery. As the occupational health program is primarily a preventive medicine program concerned with the health of the industrial population, it is administered in the field by medical officers who are responsible to the Surgeon General, via the chain of command. The industrial medical officer of the activity will be assisted by additional medical officers, nurses, administrative officers, corpsmen, and civilian technicians in sufficient numbers for carrying on an effective health program. The dental officer of the activity is directly responsible for all dental services rendered and shall be known as the industrial dental officer of the activity. He shall be assisted by additional personnel in sufficient number to provide the required dental services.

The Naval industrial health program, similar to that of other federal activities, is basically promulgated by the Bureau of Medicine and Surgery, which has recently authorized a Division of Occupational Medicine, which is guided by regulations, directives, and instructions

emanating from the Bureau of Employees Compensation of the Department of Labor, the Civil Service Commission, and the Executive Department. Such directives are translated into naval civilian personnel instructions (NCPI), released through the Office of Industrial Relations by the Secretary of the Navy for application in the industrial field as an integral part of the basic naval organizational plan. All medical aspects are controlled by the Bureau of Medicine and Surgery through its Division of Occupational and Dispensary Medicine, which has direct responsibility for interpretation and application of such instructions as are contained in the NCPI's. The standards and instructions developed by this Division of Occupational Medicine are forwarded to the 125 dispensaries without beds and to the Military Sea Transportation Service for compliance and implementation.

The industrial division of a dispensary is the responsibility of the medical officer, who represents the commander of the shipyard, or other industrial facility of the Navy, in matters pertaining to the health and welfare of the activity. When practicable, the medical officer may delegate authority to either an assistant medical officer or a civilian physician trained in industrial medicine. The Medical Department is proud of the responsibility placed upon it by administration, management, and production.

Bureau of Employees Compensation

The Bureau of Employees Compensation is a division of the United States Department of Labor. Its authority is promulgated in the Federal Employees Compensation Act of September 7, 1916, as amended October 14, 1949.

This law provides compensation for disability or for death in the line of duty. It also authorizes full medical care for civilian employees, including officer and enlisted reserves on active duty, who suffer injuries or disease in the lawful performance of their government duties. All employees are covered for all injuries at work and "diseases proximately caused by employment" except those resulting from intoxication, malingering, willful misconduct, or attempted suicide.

If it is not practicable for a naval medical officer or civilian physician employed by the Navy to provide the necessary medical services, the patient may be transferred to private physicians or community hospitals approved by the Bureau of Employees Compensation. It is preferable, however, to send the patient to other federal medical services (hospitals), if they are available.

It is the responsibility of every medical department to provide first aid and appropriate medical care at once and at a proper place for any compensable injury or disease. The injured employee must be informed by the federal physician as to the exact procedures to be followed so that he may receive all compensation and medical care to which he is eligible. Certain forms, called "CA Forms," are provided for the reports. It is important that the employees and their families be cognizant of their rights, and also it is equally important that the United States government be protected against improper claims—hence, the multiplicity of forms and reports.

Naval medical officers or designated civilian industrial physicians shall keep an adequate record of all injury cases and occupational diseases. An estimate of the degree of disability arising from the injury should be included in the record. This comprehensive information becomes of vital importance in the event of litigation or other claim against the Government. The naval physician will establish that a Form CA-1 or Employee's Report of Injury be made out in every case. This tells the employee's "story." A Form CA-20 is provided by the Bureau for use by the doctor after completion of the initial examination. In hernia cases, a Form CA-32 is recommended because hernia has been ruled by the courts a "compensable injury." In all cases of serious injury, these reports should be forwarded directly to the Bureau of Employees Compensation, Department of Labor, Washington 25, D.C., in order to comply with the regulations governing the administration of the Federal Employees Compensation Act, which states, in part, that BEC has custody of and responsibility for all records of medical and/or surgical services rendered by the government to civilian employees.

Civil Service Commission

Designated representatives of all the federal agencies meet annually in Washington as the Inter-Agency Personnel Council, previously known as the Federal Personnel Council. This Council is under the leadership of the Civil Service Commission, established under the executive branch of the federal government. It is not a subdivision of U. S. Department of Labor.

The Council discusses and formulates policies and basic guides for the administration of health programs and personnel problems of federal employees. These basic guides are then collected into a compendium called the Federal Personnel Manual. The manual is divided into various chapters, of which M, R, and P are of interest to industrial medical personnel. The "M" chapter is basically medical; "R" deals

with retirement, and the "P" chapter treats of direct personnel administrative actions.

Various divisions of the Civil Service Commission then enlarge on these basic guides formulated by the Personnel Council to make them conform with the existing federal laws and rulings or to prepare them for presentation to congress when corrective legislative action becomes imperative. The President of the United States appoints the Civil Service Commission, headed by a committee of three, one of whom is designated as the executive director.

The Commission is further divided into a number of sections, each with a division covering specific areas of responsibility in various "regions." There are 13 regional civil service offices within the continental United States with additional jurisdiction for Alaska, the Hawaiian Islands, the Caribbean, and so forth. Each regional office has a medical director, who cooperates with the government industrial health programs in his particular area.

In the Navy, the Office of Industrial Relations accumulates the rulings, regulations, and actions emanating from the civil service commission's central office and interprets their applicability as Naval Civilian Personnel Instructions (NCPI, Chapter 88). Other military services follow a similar procedure.

The medical division of the Civil Service Commission is primarily responsible for the physical evaluation and placement of the civilian employee. Physical evaluation covers not only preemployment medical examinations for particular jobs but also includes those phases of personnel actions relative to medical retirements for disease or physical disability not resulting from employment. This may involve medical retirement or separation from employment for medical reasons, depending upon the period of time the employee has worked and the nature of his physical or emotional disability. The responsibility of the naval physician may be summed up by saying that it is his duty to correlate the individual applicant's or employee's mental and physical abilities with the physical and mental requirements of the job. Approval of medical retirement is not the prerogative of the local medical facility but is, rather, that of the Bureau of Employees Compensation in Washington or of an adjudicating group in the Civil Service Central Office.

In complying with the Civil Service Commission's policy of nondiscrimination in case of the physically handicapped, the military physician should aid in allocating such an employee to an appropriate position. Statistics indicate that civilian employees with physical disabilities, when properly placed, are the best personnel in production with the least amount of sick-leave absenteeism, the lowest accident ratio, and the least compensation loss, percentagewise.

Care of Nonoccupational Conditions

White House policy statement of Public Law 658 of the 79th Congress authorized medical care of civilian employees suffering from nonoccupational conditions and/or physical handicaps. The Navy's Bureau of Medicine and Surgery has further construed this law as authority for emergency, minor, and ambulatory treatment of on-the-job illnesses and dental conditions to the end of keeping the employee at productive work. This is equivalent to mutual cooperation for mutual benefit. Application of the philosophy of "moderate treatment" or medical advice is at the discretion of the medical department of each activity. In general, its purpose is to enable the employee to continue with his work on that particular day. This practice is valuable in reducing sick-leave absenteeism. It is not intended to authorize or provide prolonged ambulatory treatment for any one condition. The Medical Department of the Navy, or of the other branches of the armed forces, does not sanction a program of medical care for civilians in competition with private or group practice.

Occupational Hygiene

All industrial medical activities in the field conduct periodic examinations for employees engaged in hazardous occupations and also special examinations for those employees whose defects may endanger the health of themselves or others. Such physical reviews are repeated at frequent intervals to insure that necessary precautions are taken to maintain and improve health, safety, and efficiency.

A voluntary annual chest x-ray program is conducted at all major industrial activities. The Navy Medical Department has mobile units to conduct such x-ray examination at smaller facilities where the necessary equipment and personnel are not available locally. The value of such an approach to industrial health has been well established and requires no elaboration.

Special examinations include studies of hazardous duty in relation to potential exposure to toxic gases or materiel, vehicular operations, radioactive emanations, and the like. Diagnostic industrial advice to the civilian employee and to management is also provided to protect the worker and at the same time to increase production.

Naval industrial medical activities are responsible for the medical phase of a sight con-

servation program to prevent injury to or loss of eyes and to increase production through better vision. To accomplish this, all civilian personnel of the Navy undergo routine visual screening and refraction, when indicated. Safety glasses are provided with appropriate corrective lenses for use of those working in eye-hazardous areas.

On Jan. 14, 1959, the Bureau of Medicine and Surgery issued BUMED INSTRUCTION 6260.6A, authorizing the establishment and implementation of uniform and effective hearing-conservation programs throughout Naval and Marine Corps Establishments. To prevent hearing loss in personnel assigned to areas of high noise intensity, the following modalities are employed: (1) audiometry, (2) personal protective measures, (3) education, (4) noise measurements and analyses, and (5) engineering control methods.

The occupational hygiene program is in reality an industrial health engineering service performed by specialists in the allied medical sciences (Medical Service Corps) who serve as industrial health engineers. This group makes a complete study of the occupational milieu in the terms of its effect upon the workers. Preventive measures are recommended to protect the individual employee from exposure to toxic materials and accident hazards. In addition, the industrial hygienist may participate in health counseling. These persons also collaborate with safety, management, and production via the medical officer.

Summary

The success of an occupational health program may be judged by the following criteria: (*a*) extension of the employee's productive life, (*b*) prevention of injury and illness on the job, (*c*) reduction of sick-leave absenteeism, (*d*) reduction in insurance premiums, (*e*) reduction of compensation costs, and (*f*) reduction or elimination of unjust claims against the employer.

To this end, every military or civilian physician on entering government employment at an industrial activity has a golden opportunity to assist the management-labor-production relationship and at one and the same time to ensure better health, safety, and environmental hygiene of the employee and the employer.

THE INSTITUTE OF INDUSTRIAL HEALTH
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THE FOURTH BIENNIAL COURSE OF INSTRUCTION

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OCCUPATIONAL SKIN PROBLEMS

October 26-30, 1959

This course will be presented by the Department of Preventive Medicine and Industrial Health, University of Cincinnati, in collaboration with the Occupational Health Program of the United States Public Health Service, and the Department of Dermatology of the University of Cincinnati. The objective of this course is to give physicians a greater understanding of cutaneous problems of occupational origin.

The program will be divided into daily sessions, consisting of morning lectures and clinical demonstrations, afternoon field instruction in industrial plants, and evening panel discussions. The didactic presentations will include a review of the anatomy, physiology and chemistry of the skin. Detailed consideration will be given to the etiology, diagnostic evaluation and treatment of occupational dermatoses, as well as specific measures for prevention and control of these problems. Current concepts regarding cutaneous cancer, allergic reactions and medicolegal problems will be discussed.

Physicians interested in attending the course should write for an application blank to Secretary, Institute of Industrial Health, The Kettering Laboratory, Eden and Bethesda Avenues, Cincinnati 19, Ohio. Early application is advised since attendance will be limited.

Topical Review

Noise and Hearing Loss—Part III

Lieut. Cmdr. Norbert E. Rosenwinkel (MC), U.S.N.
Kenneth C. Stewart, M.S., and Leo G. Doerfler, Ph.D., Pittsburgh

This is the third of a series of six reviews dealing with noise and its effect upon hearing. Subsequent installments are scheduled to appear at intervals of three months.

THE quantitative measurement of the ability of a subject to hear is the object of the rapidly developing field of audiology. At first thought this concept seems simple enough, but the administration and interpretation of hearing tests has elaborated into a complex art requiring specialized knowledge and training. In addition, a considerable body of research is being actively pursued to broaden our knowledge of this deceptively simple appearing problem. The necessity for coping with the problem of occupational deafness has thrust upon the industrial physician the urgent need for knowledge in an area which but a relatively short time ago was foreign to the industrial scene. The old "clinical" tests of hearing, spoken and whispered voice, coin clicks, watch ticks, tuning forks, and the like, are inadequate for present needs and have largely been discarded even for mass screening operations. The conduct of these tests and the conditions under which they are given lead to wide variations in results which render them useless under the requirements imposed by the medicolegal aspects of noise-induced hearing loss.

The audiologist possesses a considerable armamentarium of tests to examine the various facets of the psychophysiological function of hearing. However, industrial audiometry is limited almost entirely to pure-tone air-conduction audiometry.

There are a number of reasons for the use of pure tones in industrial audiometry. Sataloff[1] has summarized them as follows:

1. Pure tone testing methods have been standardized, and inexpensive commercial instruments for performing the tests are readily available.
2. The intensities and frequencies of pure tones can be more accurately measured than other types of sound signals.
3. The frequencies of the pure tones used for testing have anatomical counterparts in the organ of Corti, and the use of pure tones can indicate the degree of any hearing loss present.
4. A hearing defect can be detected much earlier with pure tone testing than with speech testing, and the progress of the loss can be more accurately followed.

It is to be emphasized that audiometry in the industrial setting is for the purpose of detecting loss of hearing sensitivity either already present, as in new employees, or developing, as in employees exposed to potentially hazardous environments. Although methods for evaluating hearing loss in terms of disability from the pure tone audiogram have been proposed,[2-4] none has proved entirely suitable. The Council on Physical Medicine and Rehabilitation of the American Medical Association has reiterated that the most valid way to measure the ability to hear speech is to use words or sentences.[5]

The usual instrument employed in industrial settings is the pure-tone screening type audiometer. This is the simplest type of audiometer available. The pure tone audiometer presents tones at discrete frequencies, prescribed by American Standards Association specifications. These specifications require that the frequencies of 500, 1000, 2000, 4000, and 6000 cps be avail-

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The opinions or assertions contained herein are the private ones of the authors and are not to be construed as reflecting the views of the Navy Department or the naval service at large.

able, although most commercial audiometers have additional frequencies present, usually 250, 1500, 3000, and often 125 and 8000 cps.

A volume control or attenuator dial is present to regulate the intensity of the signal presented to the test subject. This dial is usually calibrated in steps of 5 db relative to the normal threshold of hearing for the selected test frequency. The range of signal intensity is usually —10 to 100 db relative to normal threshold except at 250 cps or less or 8000 cps, where the maximum output is usually 80 db.

An interrupter switch is provided to turn the signal tone on and off. This switch may be used either to present the tone when depressed or to interrupt a continuously present tone. The former mode is more usual and, in general, is preferable in industrial audiometry. The tester is relieved of the necessity of keeping the interrupter depressed to avoid fatigue of the subject's ear by a continuous tone inadvertently administered.

An output switch is provided to direct the signal output to one or the other of the earphones or receivers.

Aside from a power on-off switch, other controls and switches may be present on commercial audiometers procured for industrial hearing testing — microphone switch, masking controls, bone conduction switch, and others. These controls are seldom, if ever, used in industrial hearing testing and are in excess of the requirements for a screening type audiometer. If present, the tester should ensure that they are turned off when engaged in routine hearing testing.

The test signal is delivered to the subject by means of earphones, or receivers. The preferable arrangement is that there be a pair of receivers joined by a spring headband, although some audiometers are available with only one phone, which the subject holds to his ear. The receivers are relatively delicate, and rough handling may throw them off calibration; therefore they should be handled with care. The earphones are usually supplied with cushions or rubber earpieces. The important fact concerning this cushion is that it is of a specific design and size, so that it encloses a known volume of air (about 6 cc). The cushion should not be removed or replaced with another type, since this may alter the air volume and disturb the calibration of the phone.

A final feature of the audiometer is a signal button which the test subject presses when he hears the test tone. This causes a bulb on the instrument panel to light. This is a generally satisfactory signal, although many experienced testers prefer a finger-raising signal.

A recent development in screening audiometry is the introduction of the automatic audiometer. These are of two types. In one form the frequency is continuously varied slowly over the range of test frequencies. The intensity of the test signal is also varying and at the start of the test is at a very low level. The intensity increases until the subject hears the test tone and presses a signal button. The attenuator then automatically reverses and the test tone becomes fainter. When the subject can no longer hear the tone, he releases the button and the attenuator again reverses, increasing the signal level. The audiogram chart moves synchronously with the change in frequency, while the writing pen is synchronized with the signal level. The resulting audiogram consists of a tracing with hearing loss displayed vertically and the change in frequency horizontally.

The other type, first designed by Rudmose,[6] is much more common in industry. In this type of instrument, the signal is presented at discrete frequencies of 500, 1000, 2000, 3000, 4000, and 6000 cps rather than being continuously variable. The automatic attenuator is similar to the one on the continuously variable frequency type audiometer. At each of the frequencies presented the threshold is determined several times and automatically recorded.

These automatic devices have several advantages. They eliminate the need for a trained operator, and, in fact, it is stated that one person can conduct several tests simultaneously on different machines. However, authorities in the field reserve judgment on these methods until certain questions can be answered.[7] Not enough studies have been made to ascertain the comparative accuracy between audiograms performed on automatic and on manual screening audiometers. An additional point of query is what point on the curve represents the threshold of hearing. As the signal varies, there is some lag in the subject's reaction in pressing the button to reverse the direction of the attenuator. Thus, the tone overshoots the threshold on the one hand and sinks below threshold on the other before the subject reacts. Until these aspects of the automatic audiogram are fully explored, these instruments, though gaining acceptance in industry, must be regarded as experimental.

Two other types of audiometric devices are available for hearing testing, the group audiometer and the audiometric screener.

The group audiometer is a device permitting the testing of groups of up to 50 persons. They exist in several forms. The main use of these audiometers is the detection of defective hear-

ing in large segments of the population, e.g., in school programs and the armed forces.

The audiometric screener is an extremely simple form of audiometer presenting one or all of the test frequencies specified by the ASA at a fixed intensity of 15 db above threshold for normal hearing. In use the subject is presented with the test tone and indicates if he can hear it. In effect, the device divides the population into two groups, those with "normal" hearing and those with defects. The latter group is tested more fully to determine the extent of any hearing defect present. The main objection to this procedure is that one of the most important features of an industrial audiometric program, the early detection of hearing defects, is obviated. Until an employee develops a loss of more than 15 db in any frequency, he is lost to close observation.

These devices are, of course, designed to simplify the problems of large-scale testing in a very short time. Unless compelling reasons for their use exist, their routine use cannot be recommended.

The recommended test procedure for industrial audiometry is the puretone air-conduction audiogram.[1, 8] Let us examine the techniques and problems involved in obtaining such an audiogram.

A typical screening type audiometer has been described above. Such an audiometer, purchased from a reputable manufacturer, meets the prescribed specifications for calibration when new. Facilities for independent verification of the calibration of instruments are, regrettably, limited to a very few laboratories. Calibration of an audiometer by physical means while extremely desirable, is often impracticable except at long intervals in the industrial setting. Most frequently, the only available means of obtaining such a calibration is to return the instrument to the manufacturer for servicing. The usual recommended period for such physical calibration is one year.

A practical field check for audiometric calibration is the frequent testing of groups of normal-hearing subjects. Such test panels are rather easily available in the industrial setting, especially among the young female office employees. The average threshold of hearing in such a group should be within 10 db of the audiometric zero at each test frequency. Failure to obtain such a result indicates either an error in audiometer calibration or excessive ambient noise in the test room, or both. Recommendations for the frequency of such routine calibration checks range from weekly to twice daily. The routine use of this check will preclude the possibility of amassing large numbers of audiograms on a machine which is grossly miscalibrated.

Errors in frequency calibration are less common and more easily detected by frequent checking of test tones on oscilloscopes or against tuning forks.

Assuming an audiometer in good working order, properly calibrated, a number of factors are operative during the conduct of an audiometric examination which might affect the results obtained. Let us examine these factors to see how errors may be minimized which might be attributable to one or more of these.

Testing Room

Although it has been well understood that noise conditions in the test room may materially affect the outcome of an audiometric examination, no quantitative standards were established for audiometric test rooms until recently. This may at first seem surprising but, except for the medicolegal aspects of hearing loss which have been concommitant with the occupational hearing loss problem, a masking effect of several decibels was relatively unimportant in the discovery of hearing defects in the school programs and other screening programs.

Audiometric examinations in industry have, as Cox[9] observes, forced a marriage between two incompatible partners, the noisy factory and the audiometer. Early attempts to obtain quiet test conditions led to some interesting situations, such as audiograms performed in walk-in refrigerators and other ingenious improvisations.

Recently Cox, at Central Institute of the Deaf, and Webster and Gates, at the Naval Electronics Laboratory, have proposed tentative criteria for permissible ambient noise levels in the testing room. Both of these criteria are in relatively close agreement as to acceptable noise levels which may be present within an audiometric test room. Both criteria allow for the added attenuation provided by the cushions on the receivers in arriving at room levels which permit measurement of zero hearing loss.

In industrial audiometry, hearing is usually tested at frequencies no lower than 500 cps; hence the masking effect of frequencies lower than the 300 to 600 cps octave band are of less importance. The criterion proposed by Cox allows an ambient level of about 37 db in this band, increasing to about 60 db in the 2400 to 4800 cps octave band. The need for testing threshold hearing at frequencies of less than 500 cps imposes more stringent restrictions on the ambient noise levels within the test room.

Test facilities which can meet these criteria

are generally not available in existing rooms in industry without special treatment or construction of test rooms. In recent years, however, prefabricated test booths have become available commercially at relatively reasonable prices. Prospective purchasers are cautioned to obtain careful data relative to attentuation of the various booths under consideration to ensure that ambient levels within the booth will fall within acceptable limits when installed in the chosen location within the plant.

A point of some interest in the commercial booths now on the market is that many of them incorporate a mechanical ventilation system. Performance of the system should be the object of close scrutiny, not for its merit in ventilation, but rather for quiet operation. Minor irregularities in installation and use, such as misalignment of ducts or damage to baffles and grills, may introduce unnecessary and unwanted sound into the test environment. Of course, the criteria for testing must be met with the ventilating system in operation.

No clear-cut opinion as to minimum size of the booth can be rendered. Many authorities feel that a contribution to the accuracy of an audiogram can be made in situations in which close rapport between the tester and subject is established by having both in the testing room.

Tester

The problem of selecting the person to conduct the audiometric examinations is deserving of close attention. The importance of the audiogram as a medicolegal document is such that extreme caution should be exercised is selecting a technician. The conduct of audiography requires the services of a person capable of performing an exacting task which may, however, become repetitive and tempt the tester into taking the audiograms in an unobservant, routine manner.

It would be ideal if all audiograms in industry could be obtained by fully qualified audiologists, but in most cases this is hardly feasible. There is available in industry a pool of professionally oriented persons within the medical department, industrial nurses, medical technicians, and others. Since audiometric testing will probably be a part time endeavor for most industries, it is wise to select the tester from among this group. On the other hand, if the hearing conservation program in an industry is on a large scale, the hiring of one or more full-time qualified technicians becomes practical.

The prospective tester, once selected, should be thoroughly indoctrinated in the principles and practices of hearing testing. Such instruction is available through courses given periodically at various colleges and universities under the supervision of fully qualified professional audiologists.

Subject

Since the audiogram is an examination based on a purely subjective response to a stimulus, proper orientation and instruction of the subject prior to examination bear heavily on the validity of the test.

The subject should have an otoscopic examination and the presence of abnormalities of the ear excluded and, if possible, corrected. Acute inflammation of the upper respiratory tract or impacted cerumen may exert a deleterious effect on the hearing sensitivity, and the presence of such conditions should be noted prior to audiometry. The subject should also be questioned as to medications currently used, prescribed or self-prescribed. The validity of an audiogram taken on a person suffering from a common cold who is taking a cold remedy containing quinine is certainly vulnerable to challenge.

On the initial audiogram, a complete, pertinent medical history should be recorded. In addition to past diseases and injuries, detailed information relative to past noise exposures, military and/or industrial should be obtained.

In instructing the subject for the audiogram itself, the directions should be kept clear, concise, and complete. The instructions must be presented pleasantly but in a definitive manner to obviate any questions or confusion which might arise later in the mind of the subject. However, it is incumbent on the examiner to ensure that the subject understands the purpose and method of the test and to secure the pleasant rapport necessary for the examination.

Conduct of the Examination

The subject should be seated comfortably during the examination. If the tester is in the test room with the subject, as many authorities recommend, the subject should not be in a position such that he can observe the panel of the audiometer or the hands of the tester. However, Sataloff[1] objects to the subject facing away from the technician, since he feels that the tester may obtain subtle indications as to the validity of the examination by observing the subject's face.

Prior to the beginning of the examination, the technician should be sure that the instrument is working properly. Once the subject is instructed and seated, the earphones should be fitted, preferably by the technician. This seem-

ingly trivial detail may be the source of considerable error and should be meticulously performed. The technician should be certain that (1) the correct phone is over the proper ear, (2) the cushions are snugly fitted to the head, (3) the headband is adjusted to the correct head size, (4) eyeglasses and jewelry are removed, (5) the pinna is not folded, and (6) the receiver is directly aligned with the external meatus. A final source of annoyance and possible error is the cord leading to the earphones, which should be placed in a manner to prevent rubbing on furniture or clothing thus introducing mechanically produced noise into the subject's ear.

Exact details of the actual audiometric examination will not be discussed, but rather certain features of the examination which might be responsible for the introduction of error will be considered.

Probably one of the most important aspects of the test is the presentation of the test tone. The tone should be first presented at a level about 20 db above the estimated threshold of the subject at the frequency being tested. If necessary, the intensity of the tone may then be increased. An initial presentation of too great an intensity may actually introduce a temporary shift in the frequency under test.

The presentation should be made in short bursts of one to two seconds or less. This short presentation is adequate and presents the subject with sufficient information to detect and identify the tone. The presentation should be random and avoid any systematic rhythm to afford the subject any extraneous clue as to when to expect the tone.

Another source of error is in the interrupter switch, which, if not handled cautiously during an examination, may emit rather loud, mechanical noises.

Other errors and invalidating factors may enter into the conduct of the examination. In large part, these errors of technique are avoidable by the employment of responsible, mature, trained technicians.

The need for accurate audiograms on all employees exposed to noisy operations is already apparent. The techniques for obtaining them within the industrial setting are available. It is up to the industrial physician to establish a program in his own department and to monitor its operation to insure the accuracy and validity of the accumulated records.

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References

1. Sataloff, J.: Industrial Deafness, New York, The Blakiston Division, McGraw Hill Book Company, Inc., 1957.

2. Fletcher, H.: Speech and Hearing, New York, D. Van Nostrand Co., Inc., 1929.

3. Tentative Standard Procedure for Evaluating the Percentage Loss of Hearing in Medicolegal Cases, Report of the Council on Physical Medicine, *J.A.M.A.* 133:396-397 (Feb. 8) 1947.

4. Kinney, C. E.: Audiometry in the Acoustical Spectrum, Sound—Wanted and Unwanted, Ann Arbor, The University of Michigan Press, 1952.

5. Principles for Evaluating Hearing Loss, Report of the Council on Physical Medicine and Rehabilitation, *J.A.M.A.* 157:1408-1409 (April 16) 1955.

6. Murray, K. F., and Rudmose, W.: An automatic Audiometer for Industrial Medicine, *Noise Control* 2:33-36, 1956.

7. Allison, R. E.: Audiometers and Their Use, *Noise Control* 3:40-43, 1957.

8. Wheeler, D. E.: Measurement of Industrial Hearing Loss, *Noise Control* 1:9-15, 1955.

9. Cox, J. R., Jr.: How Quiet Must It Be To Measure Normal Hearing? *Noise Control* 1:25-29, 1955.

24TH ANNUAL MEETING

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INDUSTRIAL HYGIENE FOUNDATION

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MELLON INSTITUTE, PITTSBURGH, PENNSYLVANIA

Hypoglycemic Agent Toxicity

B. E. Bennison, M.D., Linden, New Jersey

Side-Effects of Oral Hypoglycemics Merit Attention

There is general agreement that 1% to 3% of the adult population of the United States have a disorder of carbohydrate metabolism so pronounced as to be labeled diabetes mellitus. Since the majority of cases develop in middle adult life, it follows that almost this proportion will be present in most employee groups regardless of medical policy in effect at the time of preplacement examinations. For some of these patients, the disease will be controllable by diet alone, but the majority will be carried on specific diabetes therapy by their private physicians. While the effects of hypoinsulinism and hyperinsulinism are familiar, the advent and widespread use of oral hypoglycemic agents presents the likelihood of side-effects with symptomatology that may not be readily associated with diabetes therapy. It appears, moreover, that the patients who are most successfully controlled by oral agents, i.e., those whose disease develops after age 20 and is controlled by 40 units of insulin per day or less, are the very diabetics most likely to be found in employee groups. It seems appropriate, therefore, to bring together for reference purposes some of the recent data on oral hypoglycemic agents with particular emphasis on side-effects and toxic manifestations.[1]

Experience to Date Is Limited

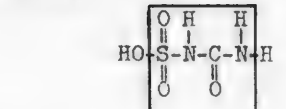
The development and promotion of the oral hypoglycemic agents have been spearheaded by pharmaceutical companies, and much of the professional literature mirrors their commercial enthusiasm. This circumstance makes difficult the true assessment of side-reactions and toxicity. A basic limitation of the findings to be discussed is the necessarily short period of observation which has as yet elapsed. Eighteen months to two years represents a long period of observation for the currently available agents. This time limitation, however, is balanced to some extent by the fact that the reported incidence and severity of side-effects may have been occasioned by high dosage schedules used in initial clinical trials.

Chemically They Are Related to Sulfonamides

In studying soluble sulfonamides similar to sulfisoxazole (Gantrisin®), early European investigators noticed symptoms of hypoglycemia. Further investigation revealed nonbacteriostatic compounds with potent hypoglycemic effects, and these were evaluated in diabetic patients. One of the first compounds widely used was carbutamide (BZ-55). It proved to have significant side-effects in about 5% of patients and was soon displaced by tolbutamide (Orinase®), which is currently showing less serious side-effects in about 3% of patients. More recently, chlorpropamide (Diabinase®) has been introduced. These three compounds are sulfonyl urea derivatives whose chemical relationships are shown in the structural formulae on the next page. The incidence and severity of toxic reactions to carbutamide may have been associated with the para-amino group. When this was replaced by the methyl group, as in tolbutamide, the toxicity was markedly reduced. This methyl group, however, is subject to oxidation in the body with resulting loss of hypoglycemic action. The halogenated ring in chlorpropamide, on the other hand, appears more resistant to metabolic degradation and imparts a more prolonged hypoglycemic effect. While only these two compounds, tolbutamide (Orinase) and chlorpropamide (Diabinase), are approved by the Food and Drug Administration at this writing, it seems likely that this small group of oral hypoglycemic agents will be rapidly augmented. Reports are currently appearing on active biguanide compounds.

Dr. Bennison is Assistant Director, Medical Research Division, Esso Research and Engineering Company.

SULFONYL UREA:



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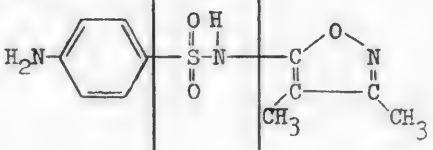
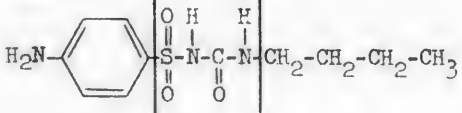
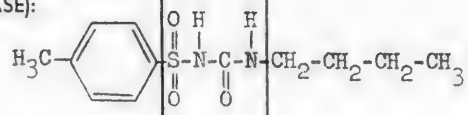


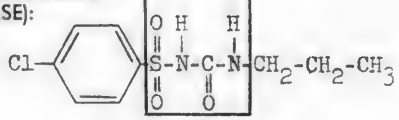
CARBUTAMIDE (BZ-55):



TOLBUTAMIDE (ORINASE):



CHLORPROPAMIDE (DIABINASE):



Mechanism of Action Is Not Clear

It appears that the oral hypoglycemic compounds are effective only when some beta cells in the islet tissue are still functioning. It has been suggested that active compounds in some way stimulate these viable beta cells to release insulin. This stimulation hypothesis is consistent with the phenomenon of exhaustion which requires that the patient be returned to an exogenous source of insulin after a period of successful oral therapy. One group of workers has suggested that the sulfonyl ureas act by inhibiting insulinase, an insulin splitting enzyme. In a provocative review article Krahl[2] suggests that the molecular architecture of the oral hypoglycemic agents may allow them to fit into receptor sites normally occupied by physiologically inert insulin, thereby greatly enhancing the effects of sub-normal amounts of endogenous insulin. It is quite clear that much remains to be learned on their mechanism of action, but it is perhaps equally significant that further study of this interesting group of compounds will open up new approaches to some of the nuances of carbohydrate metabolism which may be fruitful both in terms of basic physiology and clinical control of an important disease.

Long-Term Administration Makes Them Unique

Presently recommended dosage schedules are 0.5 to 1.5 gm per day for tolbutamide and 250 to 500 mgm per day for chlorpropamide, presumably for the lifetime of the patient. Lifetime administration of such drugs represents a relatively rare pharmacological situation. Patients with an existing metabolic defect placed on such a regimen would seem to provide a unique setting for the manifestation of chronic toxicity. This may be compounded by therapy with combinations of orally active drugs, although significant data on side-effects produced by the use of bacteriostatic sulfonamides during hypoglycemic sulfonyl urea therapy are yet to be reported.

Liver Damage Emerges as Most Serious Toxicity Problem

Jaundice has been observed in patients on oral hypoglycemics, and a fatal case of toxic hepatitis was attributed to large doses of chlorpropamide. Cholangiolitis, cholestasis, and toxic hepatitis have been confirmed by liver biopsy findings. Other hepatic findings have included transient disturbances of liver function studies with bilirubinemia, elevated alkaline phosphatase, and increased prothrombin time. Positive cephalin-cholesterol flocculation reactions have required discontinuance of therapy as early as two to three weeks. The concurrent development of jaundice is recognized as often due to factors other than hypoglycemic therapy, and in some instances this has been proved by surgical correction or subsequent drug challenge. Complete recovery from hepatitis and jaundice has occurred under continuous chlorpropamide therapy, with liver function tests returning to normal. The limited data currently available do not permit any meaningful prediction of the incidence of drug-induced hepatitis among patients being converted to oral diabetic therapy, but it would appear prudent to consider this possibility in the differential diagnosis of hepatic disorders in diabetic employees.

Gastrointestinal Complaints Are Most Frequent

As might be expected with a potent oral drug, the commonest complaints are those referable to the gastrointestinal tract. These have included peculiar taste in the mouth, anorexia, nausea, dyspepsia, epigastric distress, vomiting, cramps, abdominal pain and fullness,

and diarrhea. Gastric tolerance was found to be improved when the drug was administered with food. With respect to incidence, figures as high as 11% have been reported, but this high incidence was markedly reduced by lower initial and maintenance dosages. Although sufficiently severe in some instances as to preclude conversion to oral therapy, these gastrointestinal disturbances are usually without sequelae unless the vomiting and diarrhea further compromise electrolyte balance in a precarious diabetic employee.

Skin Manifestations Are Not Infrequent

While the newer agents seem less prone to produce drug rashes, there is ample evidence that the skin may be involved in toxic manifestations to approved oral hypoglycemic agents. Reported reactions have run the gamut from pruritus to exfoliative dermatitis and have included flushing of the skin, photosensitive rashes, macular skin eruptions, morbilliform exanthemata proved by intracutaneous tests to be nonallergic in nature, and frank allergic skin reactions. In certain instances, these reactions have necessitated withdrawal of the drug, with resultant prompt clearing. The role of at least one agent in skin reactions has been substantiated by subsequent challenge. With the wide range of skin reactions already observed, it is apparent that oral diabetic therapy will add a new differential diagnosis to the group of nonoccupational dermatoses.

False Positive Tests for Albuminuria May Occur

The relatively rapid oxidation of tolbutamide to inactive metabolites results in urinary excretion of as much as 75% of the oral dose in 24 hours. While these metabolites are apparently confortably soluble in the glomerular filtrate, their presence in the urine may give rise to a false positive test for albumin.

A Miscellany of Other Toxic Reactions Have Been Reported

Among the various side-effects that have been reported to date as relatively rare occurrences, the following may be mentioned: increased blood urea nitrogen, albuminuria, and occasional red blood cells in urinary sediments; leukopenia (counts of 2,500); eosinophilia; cross allergy between chlorpropamide and tolbutamide; questionable inhibition of thyroid function; and chest pain with occasional attacks of tachycardia.

Basic to evaluating any toxic reaction ascribed to these agents is the fact that they are potent hypoglycemic drugs. While insulin-shock-like states are not ordinarily produced by overdosage, there may be prolonged lowering of blood sugar to levels which produce the panorama of symptoms seen in hypoglycemia, i.e., weakness, anxiety, somnolence, dizziness, ataxia, sweating, and hunger. This symptomatology may be particularly troublesome and pronounced in patients with cerebral arteriosclerosis. A blood sugar level of 37 mg % has been reported in a patient on oral therapy who was eating poorly.

Several investigators have commented on intolerance to alcohol which has been seen in as many as 10% of the patients on oral therapy. Alcohol ingestion induces vasomotor instability with palpitations and flushing of the skin and, less commonly, gastrointestinal disturbances and anxiety.

Summary

The clinical usefulness of the presently approved oral hypoglycemic agents seems likely to usher in a new era in diabetic therapy. Although the pendulum is currently near the peak of optimism, significant side-effects involving predominantly the liver, gastrointestinal tract, and skin are being reported. Industrial physicians will want to bear these side-effects in mind as they periodically review the health status of diabetic employees.

Dr. Bennison's address is Esso Research and Engineering Company, Medical Research Division, P. O. Box 45, Linden, N. J.

References

1. Goldner, M. G., Consulting Editor: Chlorpropamide and Diabetes Mellitus, *Ann. New York Acad. Sci.* 74:411-1028 (March 30) 1959.

2. Krahl, M. E.: Speculations on the Action of Insulin, with a Note on Other Hypoglycemic Agents, *Perspectives Biol. M.* 1:69-96 (autumn) 1957.

Editorials

Robert T. Legge, M.D.

The JOURNAL OF OCCUPATIONAL MEDICINE extends congratulations to Robert T. Legge, M.D., upon his 87th birthday, the 16th of July, coinciding with this month's publication date. Were it our practice to dedicate issues of the JOURNAL, this one would be his.

Last month marked the 60th anniversary of Dr. Legge's graduation in medicine from the University of California. This impressive number gave us pause—and we reviewed again what is written of the career of this impressive man.

After an unusually good training for his days, Dr. Legge took the job of chief surgeon for a lumbering operation far removed from metropolitan San Francisco. Here, during the years 1900-1914, began his unmatched achievements of "firsts": excellent treatment in an organized hospital service of occupational injuries at a remote place of employment, an organized sanitation and health service for the community, and preventive industrial medicine. The years 1905-1915 have been identified as the decade during which the concepts of modern industrial medicine took shape in America. The writings of Dr. Legge and the convincing demonstration of his lumber town program were among the most important factors in this development.

In 1915 he returned to the University of California as Professor of Hygiene and University Physician, his principal activities until his retirement, in 1942. Despite his primary identification with student health work, he continued, almost as a sideline, to help industrial medicine take form: as an organizer and first vice president of the old American Association of Industrial Physicians and Surgeons, in 1916; chairman of the Section on Industrial Hygiene of the American Public Health Association; chairman of the Section of Preventive and Industrial Medicine and Public Health, of the American Medical Association; a member of the A.M.A.'s Council on Industrial Health; and as a leader and developer of the Western Industrial Medical Association. He delivered the Oration at the first meeting of the Ramazzini Society, and was recipient of IMA's Knudsen Award in 1951.

A standard final paragraph would carry the assurance that Dr. Legge's health and activities continue unabated, except that in his case this is taken for granted by his friends, who would never think to inquire about the point. Study, writing, travel, and gardening continue for him and his wife at a lively pace. We wish them many more full years!

Free Choice of Physician

The resistance of organized medicine to the growth of prepaid medical services provided by closed panels of physicians has flared at different places in accordance with the growth of plans and the responsive antagonism of

physicians at those places, and around different issues. The issue with the greatest durability and widest appeal has been that dealing with "free choice of physician." Those opposed to prepaid care by closed panels have held that the great wrong of such systems is that they necessarily deprive the patient of this choice.

The question of free choice was one which had to be faced by the American Medical Association's Commission on Medical Care Plans, widely known by the name of its chairman, the Larson Commission. It turns out that the phrase is not readily defined. One is reminded of the years of effort and countless legal proceedings required to define the key words of the Workmen's Compensation laws which provided benefits for accidental injuries "arising out of and in the course of employment." The shorter phrase, free choice of physician, although lacking an imposing array of prepositions, does have some nouns which have many meanings for many people.

In an earlier discussion (Report of the Larson Commission, Editorial, J. Occup. Med. 1: 126, 1959) we noted the consideration in the Report that ultimately no patient has a free choice of physician because, according to Section 5 of the Principles of Medical Ethics, ". . . 'a physician may choose whom he will serve' . . . in which case the patient may be denied his choice." The Report also gives recognition to the indirect denial of free choice inherent in the staffing of hospitals on the bases of specialty certification and other considerations imposed by the physicians themselves in the interests of quality care. Other restrictions upon the patient's exercise of free choice, long accepted by all parties concerned, include the selection by employers, in most states, of physicians to treat employees sustaining occupational injuries; and the designation by hospital boards of physicians responsible for special diagnostic procedures provided in the hospital.

The Commission made two recommendations that bear upon the free choice issue. These are quoted directly: "'Free choice of physician' is an important factor in the provision of good medical care. In order that the principle of 'free choice of physician' be maintained and be fully implemented the medical profession should discharge more vigorously its self-imposed responsibility for assuring the competency of physicians' services and their provision at a cost which people can afford. . . . Those who receive medical care benefits as a result of collective bargaining should have the widest possible choice from among medical care plans for the provision of such care."

The AMA's House of Delegates, at its meeting in Atlantic City on June 10, 1959, approved these recommendations.

The approval was an unfortunately belated recognition of a de facto situation. An unknown but certainly large number of American physicians decided long ago that they could carry on medical practice of the highest quality quite independently of the free choice consideration. The allegation that these men were ethically outside the pale was based on an uncomfortably thin premise. The unfortunate frictions that developed in the community of practitioners as a result of the allegation should now be put behind us. There are other days ahead, and more work than we can possibly get done.

NEW YORK STATE SCHOOL OF INDUSTRIAL AND LABOR RELATIONS

CORNELL UNIVERSITY

will present a conference on

LABOR RELATIONS ASPECTS OF INDUSTRIAL MEDICINE

October 22-23, 1959

Gideon Putnam Hotel, Saratoga Springs, New York

Discussions at this meeting will concern definitions of industrial medicine, its history and development, mutual problems of the industrial physician, the union representative and industrial relations personnel, and the anticipated effect of automation on industrial medicine. Program details will be published at a later date. For further information, if desired at this time, please communicate with the Capital District Extension Office, 11 North Pearl Street, Albany 7, N.Y.

Industrial Medical Association

THE PRESIDENT'S MESSAGE

D. JOHN LAUER, M.D.

DURING the month past the American Medical Association in annual meeting gave consideration to the much heralded "Report of the Commission on Medical Care Plans" (the "Larson Report"), which was published as a special supplement to the January 17, 1959, issue of the *Journal of the American Medical Association*. The House of Delegates voted to *receive the report for information only* and to accept the *recommendations* made in the report with but a few minor changes.

Our officers felt it important that all members of the Industrial Medical Association be familiar with this report and, further that we make known the views of the IMA in respect to it.

Therefore, the Committee on Industrial Medical Practice, headed by Dr. Preston Barton, was asked to study the Larson Report and to express its reactions. This assignment they carried out with promptness and directness. On the basis of the Committee's advice, that of the Executive Committee, and others, the following statement has been formulated. The statement directs itself only to that section of the Larson Report which discusses Industry Programs.

I. The Commission's questionnaire to 3000 industrial physicians was the basis of certain of its significant conclusions regarding industrial medical practice. While there may be some question with respect to the survey, the fact remains that this is the only such survey conducted to date, and its findings are the best available. We select three points for particular emphasis: (1) Some occupational health programs are inadequate, and should be enlarged. (2) Other occupational health programs go too far, especially in the management of non-occupational cases. (3) There is some lack of understanding between industrial physicians and private practitioners in matters related to the medical care of industrial employees.

II. The A.M.A.'s statement on "Scope, Objectives, and Functions of Occupational Health Programs" was adopted two years after the Commission's survey of industrial practitioners by means of the questionnaire. Undoubtedly, this statement has favorably influenced industrial medical practice. It should be given wide publicity with the hope that it will continue to have salutary effect upon industrial medical practice.

III. Broad programs of preventive medicine in industry must be encouraged. These programs result in early case finding, with early referrals of patients to their private physicians while potentially serious problems are still manageable. All studies to date indicate that such programs develop more practice for private practitioners. We are proud of the contribution that occupational medicine has made to the health of the nation through the teamwork between the industrial physician and the private practitioner.

IV. The working man stands to benefit from cooperation between the family physician and the industrial physician. When this cooperation breaks down, the worker and the medical profession both lose. Effective cooperation can exist only on a two-way street, on which the industrial physician and the private practitioner both recognize their responsibilities and limitations.

Our Committee on Industrial Practice feels a resurvey of the IMA members on the types and scope of their industrial health programs is indicated. We encourage that project. Copies of "Scope, Objectives, and Functions of Occupational Health Programs," may be obtained from our headquarters office. This statement may help bring about better understandings in your county and state medical societies.

Book Reviews

INDEX OF OCCUPATIONAL HEALTH AND SAFETY LAWS, CODES, RULES AND REGULATIONS, BY STATE AND BY SUBJECT. Revised July, 1958. Report was prepared by Lloyd W. Larson under the general direction of Beatrice McConnell, Chief Division of State Services, Bureau of Labor Standards, United States Department of Labor.

For those interested in the specific legislation of the various states related to the control of occupational hazards, this index provides a basic reference. Divided in two sections, Part I discusses occupational health and safety laws, codes, rules, and regulations according to state. In Part II, these same matters are catalogued by subject. Codes promulgated by one agency and enforced by another, are listed under the enforcing agency with footnotes indicating the rule-making agency.

Fire or mine safety provisions, however, are not included when administered by agencies other than the labor department. Provisions primarily concerned with public health or public safety, such as regulations on the use of fluoroscopic shoe-fitting devices are also omitted as are regulations on industrial housing and migratory labor camps.

This publication is a ready source of reference for official agencies, teachers, students, and others concerned with the legal basis of occupational health activities. —RONALD F. BUCHAN, M.D.

THE UNCOMMON MAN: THE INDIVIDUAL IN THE ORGANIZATION. Crawford H. Greenewalt. Price, $4.00. Pp. 142. New York, McGraw-Hill Book Company, Inc., 1959.

This book is based upon a series of lectures given at the Graduate School of Business Administration at Columbia University. The author is arguing against the thesis advanced by William H. Whyte, Jr. in "The Organization Man." He says that modern American business succeeds to the extent that individuals are encouraged to exercise their best talents in their own particular way, and that these people are given the maximum incentive for achievement in order to do so. He feels that the ablest performers are essentially rugged individualists, and do not conform to any particular type of pattern. He states, for example, that "The responsibility of management in any organization is to provide such conditions as will inspire, among as large a group as possible, the unusual rather than the perfunctory effort." When the author comes to grips with conformity, he appears to do rather well. He states on page 50, "Conformity in behavior is a human necessity; conformity in patterns of thought a human danger." This book contains an interesting chapter on the executive function which well repays reading.

One has the impression that Greenewalt has presented a case in defense of the individualist, but it also appears that his theoretical position is by no means sound and that he has not really met the implicit challenges arising out of the drift towards conformity. —GRAHAM C. TAYLOR, M.D.

HANDBOOK OF ORGANIC INDUSTRIAL SOLVENTS. Price, free. Pp. 72. Chicago, National Association of Mutual Casualty Companies, 1958.

"A Handbook of Organic Industrial Solvents" recently compiled and published by the National Association of Mutual Casualty Companies with the advice and help of a number of well-known authorities in industrial toxicology will be of considerable help to safety engineers, industrial physicians, and hygienists as well as to labor and management in the recognition, evaluation, and control of safety and health hazards arising out of or associated with the use of these materials. The compilation lists the more important characteristics and properties of 225 commonly used organic solvents and provides synonyms for each substance named both in the table and in a special index. Methods of control are outlined in a clear and direct manner. The outline of the more important properties of the solvents, listed together with concise statements as to the possible effects of such solvents on humans who may be exposed to significant amounts, will enable anyone interested to use the booklet quickly to good advantage. It should be available in every industrial safety and medical department.

—CARL A. NAU, M.D.

THE ALCOHOLIC WORKER: National Industrial Conference Board Studies in Personnel Policy, No. 166. Stephen Habbe. Price, for Conference Board Associates, $2.00; for Non-Associates, $10.00. Pp. 52. New York, National Industrial Conference Board, 1958.

The introduction to this report states that it "is better described as a compilation than as a product of original research." As such it should serve a useful purpose in an area of confusion and ignorance. It is probably impossible to gain unanimous agreement as to the meaning of words such as "alcoholic," "alcoholism," "problem drinker," "disease," etc. Nonetheless, a number of far-sighted managements have recognized a problem and have dealt with it in a forthright and often rewarding manner. Much information regarding these efforts is included in this concise report.

The role of the medical department in industry in dealing with these cases individually and collectively is not clear. Perhaps too much emphasis is placed upon the doctor's role. Certainly he can be a valuable helper but his effectiveness is dependent upon early case finding by lay supervisory personnel and forceful action by top management when lack of proper motivation precludes successful rehabilitation of any worker.

This report is recommended reading for physicians in industry, personnel officers, and management. —LEO WADE, M.D.

Abstracts of Current Literature

Noise and Hearing

Horace O. Parrack, Ph.D.

Temporary Hearing Loss at 4000 C. P. S. as a Function of a Three-Minute Exposure to a Noise of Uniform Spectrum Level. J. D. Miller.* Laryngoscope 68:660 (March) 1958. (*Department of Psychology, Indiana University, Bloomington)

The temporary hearing loss (more commonly called temporary threshold shift, TTS) for a test frequency of 4000 cps produced by a noise of uniform spectrum level, between 60 cps and 7000 cps, at varying over-all sound pressure levels was investigated on eight subjects who had normal hearing. The study sought to relate the TTS produced in each listener to the intensity of the noise and to observe how this relation changes during recovery from the TTS. The average TTS for the eight subjects, measured 15 seconds after a three-minute noise exposure to each sound pressure level (SPL) given as follows: SPL 85 db, TTS is 4 db; SPL 95 db, TTS is 9 db; SPL 105 db, TTS is 23 db; SPL 115 db, TTS is 37 db; SPL 120 db, TTS is 46 db. Six minutes after the end of the noise exposure, TTS was as follows: SPL 85 db, TTS is 2 db; SPL 95 db, TTS is 3 db; SPL 105 db, TTS is 10 db; SPL 115 db, TTS is 17 db; and SPL 120 db, TTS is 15 db. Recovery from TTS was observed for about 12 minutes, at which time the mean TTS for the eight subjects was as follows: SPL 85 db, TTS is 1.1 db; SPL 95 db, TTS is 2.6 db; SPL 105 db, TTS is 8.4 db; SPL 115 db, TTS is 14.5 db; and SPL 120 db, TTS is 12.7 db. Two persons recovered more slowly than the rest of the subjects when the SPL during exposure exceeded 110 db. These data demonstrate some of the immediate effects on the ear of short exposure to noise of varying SPL.

Observations on Temporary Auditory Threshold Shift Resulting from Noise Exposure, II. A. Glorig,* A. Summerfield, and W. D. Ward. Ann. Otol. Rhin. & Laryng. 67:838 (Sept.) 1958. (*Research Center, Subcommittee on Noise, 111 N. Bonnie Brae St., Los Angeles 26)

The temporary threshold shift (TTS), at 4000 and 1000 cps produced in 15 normal-hearing subjects exposed to broad band noise has been investigated, together with the recovery from TTS at 4000 cps, after a pilot study demonstrated the feasibility of such studies. Continuous exposure to the noise at an over-all sound pressure level of 106 db produced at 4000 cps the amount of TTS shown for specific durations of exposure: 10 minutes—TTS is 19 db; 20 minutes—TTS is 25 db; 50 minutes—TTS is 33 db; and 100 minutes—TTS is 41 db. When the noise was on for 30 seconds, followed by a 30 second interval of no noise during the same total time periods, the results were as follows: 10 minutes—TTS is 9+ db; 20 minutes—TTS is 12 db; 50 minutes—TTS is 17 db; and 100 minutes—TTS is 20+ db. Other experiments were made with the noise on 67% and 33% of the total exposure time. The results from these experiments can be summarized as follows: Growth of TTS at 4000 cps is related linearly to the logarithm of the exposure time; the rate of growth of TTS is approximately proportional to the fraction of the time the noise is on. When the noise is on 100% of the exposure time and the over-all sound pressure level is varied, for example, 106 db, 100 db, 94 db, and 88 db, the data showed the rate of growth of TTS to be proportional to the number of decibels by which the sound pressure level exceeded 85 db; for an exposure of 100 minutes the TTS for specific sound pressure levels were 106 db—TTS is 41 db; 100 db—TTS is 27 db; 94 db—TTS is 17 db; 88 db—TTS is 7 db. The recovery studies at 4000 cps can be summarized by stating that if the TTS is less than 50 db, the recovery rate appears to be proportional to the initial TTS. Production and recovery of TTS at 1000 cps shows the same general characteristics as at 4000 cps but the amounts of shift and rates of its production are much smaller for a given noise exposure. When exposures were made to noises that alternated in sound pressure level, between 106 db and 96 db (each level alternately present for 30 sec.), the TTS was intermediate between that for 106 db only and 96 db only and was essentially the same as the TTS produced by a level of 101 db lasting for the same length of time.

Temporary Threshold Shift from Octave-Band Noise: Applications to Damage-Risk Criteria. W. D. Ward,* A. Glorig, and D. L. Sklar. J. Acoust. Soc. America 31:522 (April) 1959. (*Research Center, Subcommittee on Noise)

This article is a report on the growth and recovery of temporary threshold shift (TTS) attending exposure to octave-bands of noise (300-600 cps; 600-1200 cps; 1200-2400 cps; and 2400-4800 cps bands). The sound pressure levels (SPL) of these bands were varied (85 to 105 db), as were the durations of exposure (12, 22, 37, and 102 minutes), and the TTS was measured for several different frequencies between 1000 cps and 6000 cps. The data and the results of the analyses are presented in seven figures and four tables. Equations were developed for the growth of TTS for the test frequencies used and for the four octave bands of noise studied. Formulae were also developed for computing the recovery of TTS after exposure to one band of noise alone or to combinations of two or more bands. The formulae differ somewhat from those developed earlier for the growth and recovery of TTS resulting from exposure to wide band noise (75 to 9600 cps). Using the equations presented in the paper, one can compute the sound pressure level of a particular octave band that will

produce a TTS of 40 db (or some other selected TTS level) for a particular test frequency after an exposure of eight hours (480 minutes). For example, an exposure of 480 minutes to a 600-1200 cps band of noise will produce a TTS of 40 db at 1500 cps if the SPL is 109 db. For the same band to produce a TTS of 40 db at 2000 cps requires a SPL of 109 db. An exposure of 480 minutes to noise restricted to the 2400-4800 cps band will produce a TTS of 40 db for 4000 cps when the SPL of the band is 93 db. Similar computations were made for other octave bands and test frequencies. In general the band SPL's required to produce a reasonable TTS (40 db or less) for various test frequencies, after an eight-hour exposure, were found to fall near the band SPL's stated by several recent criteria for maximum permissible noise-exposure.

Dependence of Temporary Threshold Shift at 4 kc on Intensity and Time. W. D. Ward, A. Glorig, and D. L. Sklar. J. Acoust. Soc. America 30:944 (Oct.) 1958.

This article contains a detailed analysis of experimental data from a study of the growth and recovery of temporary threshold shift (TTS) at 4 kc in 13 subjects exposed for varying times to varying levels of a broad-band noise of essentially equal sound pressure level per octave band from 75 cps to 600 cps. The experimental data and results of analyses are presented in 10 figures and 4 tables. A formula for the growth of TTS at 4 kc is derived from the data. The formula is $TTS_2 = 1.06\ R\ (S - 85)\ [\log_{10}\ (T/1.7)]$, where TTS_2 is the TTS two minutes after the cessation of an exposure, lasting T-minutes, to a noise having a sound pressure level (SPL) of S db; R is the fraction of the time the noise is on. The equation holds when T is greater than 5 minutes and when S is greater than 85 db and up to at least 110 db. Recovery of TTS after two hours of exposure is described by the formula $TTS_t = TTS_2\ [1 - 0.37\ \log_{10}\ (T/2)]$, where TTS_t is the TTS that remains after t-minutes of recovery. The equation holds if t is two minutes or more and when TTS_2 is not greater than 50 db. The authors explicitly state the limitations of the equations and the generalizations indicated by the data. The formulae provide methods for computing TTS for a limited range of exposure levels and exposure times. A person who desires to make these computations must examine the methods in detail.

Age and Sex Differences in Pure-Tone Thresholds. J. F. Corso.* J. Acoust. Soc. America 31:498 (April) 1959. (*Department of Psychology, The Pennsylvania State University, University Park, Pa.)

The author presents the data from a study on a population that should have experienced minimal exposure to industrial noise throughout the life of the individuals. One aim of the program was to obtain a description of the average normal hearing thresholds for persons in the United States in the age range 18-24 years (the age at which employment begins) for use in estimating the effects of exposure to industrial noise. Since aging is presumed to be accompanied by some elevation of the hearing thresholds, the same data are required for older age groups. The age groups studied were 18-24 years; 26-32 years; 34-40 years; and 43-49 years. The data are presented in five extensive tables and three figures. The author concludes that the results of the study should provide data of considerable importance in revising present standards of normal hearing. He further recommends that future standards for normal hearing and other associated audiometric standards be specified independently for men and women according to particular age levels.

Medical Care Administration

Asa Barnes, M.D.

Should an Occupational Health Program Be Included in Local Health Department Activities. William L. Wilson.* Am. J. Pub. Health 3:355 (March) 1959. (*Director, Division of Occupational Health, State Department of Health, Austin, Texas)

Several disciplines are essential to a successful local development of an occupational health program. No one discipline, no one profession, no one specialist, has the exclusive capacity to provide multiskilled activities organic to occupational health. Many local health officers have delayed outlining their own occupational health program because no immediate increase of budget is authorized or is in view. There needs to be established adequate state and local government occupational health programs, and a local director can and should demand state support. As a minimum, this support should establish standards of sanitation and hygiene of working environments, furnish investigations and studies of occupational health problems, provide current information and knowledge of materials, methods, and processes which will improve workers' health, provide training of local personnel, and provide consultations and advice on problems or unusual circumstances. No occupational health program of a local health department will succeed any more than the health officer wishes it to, and none any less.

Socialized Medicine Floundering in Germany. HNI Correspondent in West Germany. Der Spiegel. (Health News Institute, 60 E. 42nd St., New York)

In West Germany 80% of the population are covered by socialized medicine, 12.5% are covered by private insurance, 5% are without any coverage, and 2.5% are covered by poor people's aid. About 15% of all people covered by socialized medicine are persons who take advantage of the low rates even though they are now in economic circumstances where they can well afford to take care of their medical problems. There is so much inter-

est in taking advantage of social insurance that a company employing 5,000 persons requests 5,000 sickness certificates per quarter. Persons covered feel cheated if they do not obtain something from the system.

The average contribution for a worker amounts to 8.5% of base pay. Because a German worker must pay 14% of his gross earnings to the retirement income Fund, 2% to unemployment insurance, 2.4% to accident insurance, and 1% to family insurance, his total deductions for social purposes amount to nearly 30% of his income.

The German Government is wrestling with the problem of reforming its social insurance system but is caught between union demands to make matters convenient for the workers, the financial problems of the system, and the problems of the German physicians under the system.

Footsteps on the Frontier: Some Observations on the "Third Party" in Medicine. Raymond M. McKeown.* J.A.M.A. 166:315 (Jan. 25) 1958. (*Coos Bay, Ore.)

The general public has become deeply interested in problems of health and welfare. This interest is world wide. All are familiar with the past and present activities of some political parties and of some individuals who have sought to enhance their political power and prestige by proposing schemes of national health socialization. The complete history of the third party has yet to be written. It is so variable in nature and interpretation throughout the field of medical economics that one is sorely tried at times to tell just where it begins or ends. It is not a new concept but was described in ancient Greece.

The medical profession has been shown repeatedly the necessity for it to anticipate medical economic trends. The practice of medicine in realms of economics evolves slowly. The increasing demand from the public for more and more coverage poses a problem of deep concern for those interested in the third party in medical care, the more service the customer requires the greater and higher the cost. The art of medicine has no price tag. the availability and modes of distribution of medical care do.

The future course of the third party in medical care rests on the understanding and reaction of the medical profession. Leadership, even statesmanship, is critically needed. Without it we will be in for changes in medical practice of a far-reaching extent.

United We Stand—Divided We Fall. John Lister.* New England J. Med. 260:655 (March 26) 1959. (*London, England)

The author traces a portrait of the doctor through the ages as a member of society beginning with the doctor of Chaucer's day. By the fifteenth century the vested interests of medicine began to compete with each other. The main groups were the physicians, the apothecaries, the surgeons, and the barbers, with such others as the quacks, midwives, herbalists, and alchemists all in the fight.

In the eighteenth century the gold-headed cane became the physician's symbol of office and helped impress the patient. During the latter part of the nineteenth century the rise of the surgeon was given great impetus by the discovery of anesthesia and antiseptic principles. The general practitioner began to assume the role of family counselor and friend. In 1906 George Bernard Shaw, in the preface to the play "The Doctors Dilemma" suggested that the doctor's self-respect would be increased and his temptations diminished if he were paid a fixed salary. The medical profession could then become "a body of men trained and paid by the country to keep the country in health."

Lister points out that the first socialized medicine came to England with Lloyd George's National Insurance Bill in 1911. The National Health Service in 1948 was accepted in principle by both parties. After 10 years the medical profession is in a state of flux and the doctor himself is a controversial figure for which he is partly to blame. The interests of the general practitioner and the consultant are often at variance. The structure of the National Health Service is partly the cause because the general practitioner service and the hospital service are quite separately administered. The profession in England can lay its weakness to the fact that it is divided within itself. Lister states that the present demand should be for unity within the profession itself because a divided profession can never be strong: united we stand—divided we fall.

On Choosing a Surgeon. Donald Munro.* New England J. Med. 258:74 (Jan. 9) 1958. (*Milton, Mass.)

Four cases are outlined in which the patients chose or permitted doctors to treat their serious complaints without knowing anything about the doctors' capabilities. Each doctor, according to his lights and capacities, did the best he was capable of doing, with regrettable results. Most actual and potential patients have never been taught to make a judicious choice of physicians. They still feel that any licensed physician can treat them as well as any other licensed physician and that all members of the surgical staff of any teaching hospital stand at the head of their profession. The correction of such unfortunate and tragic ignorance and the education of the public in the proper evaluation of their physicians' competence must and can come only from members of the profession itself. They are the only ones capable of accurate judgment of capabilities of their individual members and of controlling their activities. The educational effort falls into two great divisions, raising the capacities and standards and increasing the personal knowledge of the surgeons themselves and equal and analogous educational efforts directed toward the public and the patients themselves. The public is provided with no guides to the competence of the members of the profession who are to diagnose and treat them.

Prominent employers of labor, community, civic, labor organizations, and others will welcome a practical plan for an educational campaign to provide necessary and appropriate education. Munro suggests that the physicians of the New England Surgical Society attempt to teach the individual patient the things he needs to know to determine for himself whether or not the doctor he consults is the proper one to solve his particular problem. In this way the millenium, in which every doctor treats each of his patients in the same way as he would want the members of his family to be treated under similar circumstances, will be brought a little closer.

Mental Health

Graham C. Taylor, M.D.

Two Schools of Thought About Executive Development. E. E. Jennings. Personnel Journal 37:370 (March) 1959.

This brief article points out that there are two commonly held theories of executive development. The first Jennings has called the life-process theory, and the second, the skilled insight theory. In essence, the former theory holds that executives or executive performance are the end-result of many years of experience with the executive role and that brief training periods cannot essentially contribute anything to the executive's performance. On the other hand, the skilled insight theory argues that particular skills can be taught to the executive in the course of training and educational programs, so that the executive may greatly improve his performance.

The author indicates that the organizational climate varies from one type of industry to another concerning adherence to these schools of thought. He does not indicate which school he favors.

Psychiatric Aspects of the Adult Patient in the General Hospital. H. K. Fischer.* Pennsylvania M. J. 62:705 (May) 1959. (*Temple University Medical Center, Philadelphia.)

There can be treatment of psychiatric and psychosomatic problems, in adult patients in the general hospital. This treatment is advancing rapidly, as the techniques of effective psychotherapy are developed, and also with the availability of new tension reducing drugs. This can lead to an earlier referral of patients to general hospitals, so that there need not be the impression that the employee must be either treated in a psychiatric clinic or in a state mental hospital. The nonpsychiatric physician has a unique opportunity to diagnose and explore possibilities for psychiatric treatment of patients who are under stress long before they are referred to a psychiatrist. "This demands that the family and non-psychiatrist become more aware of the physical, emotional and mental signs and symptoms attending a breakdown, so that they can be handled earlier when treatment is easier." "In order to fulfill his role in diagnosing psychosomatic, emotional and mental illnesses early, the non-psychiatrist must learn to identify and understand something about a wide variety of psychiatric and psychosomatic problems. In the past he might have only studied the physical problems, told his patient that there was nothing wrong with him or that his trouble was in his head and dismissed him. This is no longer acceptable since many of these patients do not get well spontaneously and too frequently the delay in starting psychotherapy causes the development of a much more complex and difficult problem."

There are some remarks on the suicidal patient, on the psychiatric aspect of chronic illnesses, and on the management of acute alcoholism.

Psychological Aspects of Accident Causation. J. MacIver.* Indust. Med. & Surg. 28:230 (May) 1959. (*80 Maiden Lane, New York 38.)

Although there are psychological factors involved in accidents, and cannot glibly state the reasons for them because "accident research and prevention activities are at least as complex as similar activities now being carried out in cancer and heart disease." Psychological factors are important with respect to accidents but by no means the only relevant factors. We should "train ourselves to watch for danger signals in our thoughts and actions, our behavior in general, and to the extent that these feelings are conscious, we can take steps to counteract them." Reference is being made here to destructive impulses, sometimes directed against ourselves, sometimes directed against others, with the realization that these feelings may sometimes be partly within and partly without our general sphere of awareness. Concerning the obtaining of data on the psychological aspect of accidents, we should by means of a nondirective interview determine as soon as possible the accident victim's reaction to the accident in his own words, and also determine how his family and work relationships have been in the recent past, and in particular, how the accident victim felt just before the accident. That some people are accident prone and others not is an assumption all too frequently made. People may be temporarily accident prone at one time or another. He concludes that: "The truth of the matter is that the study of accident causation and all of its facets is one of the most complex problems facing our civilization. The elucidation of the accident problem will require the employment of our best skills and resources."

Of Time and the Worker. P. Fraisse.* Harvard Business Review 57:121 (May-June) 1959. (*Sorbonne, Paris, France.)

Man's life is a series of cycles, and the human organism adapts itself to the various rhythms. In particular, in industry we are concerned with alterations in the work schedule and alterations in the temporal horizon of workers. Fraisse refers

to the "psychosomatic consequences" of repeated changes of schedule, and he quotes observations to the effect that workers who change shifts frequently may develop disorders of the autonomic nervous system. Of interest is his reference to the fact that body temperature is used as an indicator to follow the cyclic fluctuations, presumably on a daily basis. He states that according to German studies "the frequency of gastric ulcers among workers in alternating shifts is eight times as great as among those who have a regular rhythm of work." The reference to this is not given, however, nor are the supporting figures presented.

Turning to the notion of "temporal horizons," he indicates that people vary in their conception of the past and of the future. To some people the past may be very important and the future may be relatively closed, whereas to others the future may hold great promise. To others there may be no great interest in either the future or the past. An understanding of the temporal horizon of the employee is hence of considerable importance. The author states, in conclusion, that "we see that desynchronization of biological and natural rhythms involves man in tension, and ultimately menaces him with dehumanization. On the other hand, we find psychological adaptations which amount to nothing more than forms of sclerosis."

He argues finally that if we can extend our present limits, perhaps by using group motivations we may achieve new possibilities and new horizons.

Reparative Surgery

Robert J. Trettin, M.D.

The Severed Flexor Tendon. J. William Littler.* S. Clin. North America 39:435 (April) 1959. (*14 E. 90th St., New York 28)

Strict adherence to the principles of tendon repair and careful technique will give good results. A bloodless field, properly placed incisions for exposure, a knowledge of functional anatomy, and a repair of pertinent divided structures with minimal over-all tissue damage are essential to uncomplicated healing and useful function. If experience or local conditions do not favor a primary procedure, it is far better to delay a nerve or tendon repair. The wound is carefully sutured, and little or no debridement is required in simple lacerations. Severed digital nerves should be meticulously coapted with braided 0000000 eye silk on an atraumatic needle and the hand immobilized in the optimum functional position. A secondary tendon repair can then be performed approximately six weeks after the injury.

Features pertinent to the site of the flexor tendon laceration are discussed and the technical aspects of tendon repair are outlined. A successful result is favored when the juncture can be placed either in the soft tissue of the palm or wrist or at the insertion. An injured or repaired tendon will not function satisfactorily through an area of scar or through a fibro-osseous tunnel.

Skin Grafting in Burns. William P. Wahlen.* S. Clin. North America 39:421 (April) 1959. (*111 E. 61st St., New York 21)

The third-degree burn represents an irreparable loss of an important organ and, except in minimal areas of loss, should be treated surgically. Conservative therapy is contraindicated from both a morbidity and a mortality viewpoint. In nongrafted wounds epithelization progresses from the surrounding skin edges approximately ⅛ inch a week. Thus, in the more extensive cases there can be no justification for postponing operation. The various suggested dressings with ointments and solutions are valueless in the third-degree burn. Skin coverage must be provided as soon as possible to restore the destroyed functions, the most important of which is the defense against infection. Early excision and grafting are indicated in more extensive burns, up to 25% of the body surface, and also in less extensive burns involving moving areas.

The author outlines procedures for the care of the wound and for skin grafting following separation of the burn eschar. He also concludes that a completely satisfactory enzyme that will safely and adequately remove the eschar is not available to date.

The Immediate Management of Severe Maxillofacial Injuries. Thomas D. Rees.* S. Clin. North America 39:379 (April) 1959. (*39-A E. 72nd St., New York 21)

The incidence of acute maxillofacial injuries is on the increase and presents a challenge to all surgeons concerned with trauma. In general, excellent results can be obtained if basic surgical principles are adhered to. The author discusses in detail the first-aid management, diagnosis, and definitive treatment of acute injuries to the soft tissues and bones of the facial structures. Certain principles are emphasized: (1) evaluation for tracheotomy; (2) performance of a detailed local physical examination; (3) use of free skin grafts in avulsed facial wounds; (4) initial repair of lacerations by zigzag or "interlocking Z-plasties"; (5) fixation of facial bone fractures by the simplest possible techniques.

The importance of giving psychological support to patients with facial injuries during their early management is reiterated. The threat of facial disfigurement is foremost in their minds. The surgeon should be gentle, reassuring, and encouraging throughout treatment.

Should Antibiotics Be Used in Large Bowel Preparations? R. Robert Tyson* and Earle H. Spaulding. Surg. Gynec. & Obst. 108:623 (May) 1959. (*Department of Surgery, Temple University Medical Center, Philadelphia)

Surgeons for years have tried to improve the methods of preparing the large bowel for surgery. The advent of modern chemotherapy resulted in a marked acceleration of research in this field as a

continual succession of new antimicrobial agents appeared, each reputedly better than its predecessors. Unfortunately, the "sterile bowel" promised by the proponents of these agents fails to materialize when the results are subjected to careful analysis.

The question as to whether antibiotics should be used for bowel preparation cannot be answered categorically but must be decided by each physician after he has studied the situation. After more than five years of research and much consideration of the subject, the authors decided to abandon the use of antibacterial agents in the bowel preparation procedure in all cases uncomplicated by significant obstruction, significant arteriosclerotic vascular disease, or anticipated extensive surgery because the advantages do not often enough outweigh the disadvantages.

Level of Amputation in Third Finger. Robert E. Carroll. Am. J. Surg. 97:477 (April) 1959.

The third digit of the hand is the main axis in anatomical construction and of hand function. Both abduction and adduction are determined from this point of reference. The function closely parallels that of the index finger. Preservation of length will depend on obtaining the best permanent finger for function. The author discusses the acceptable levels of amputation in the middle finger. Disarticulation through a joint is unacceptable as a final procedure. The condyles of the distal portion of the phalanx should be rounded off to give a dome-shaped end to the stump of bone. In general, when only the base of the distal or middle phalanx remains, it is better to use a level of the distal portion of the proximal phalanx. A level of less than three-quarters of the proximal phalanx is not acceptable. Carroll advises removal of the residual phalanx and the entire third metacarpal, transposing the index ray to replace the third digit at this time, or as a second procedure. Excellence in function and a good cosmetic result are thereby achieved.

Wound Healing: II. An Evaluation of Surgical Suture Material. R. W. Postelthwait,* J. F. Schauble, M. L. Dillon, and J. Morgan. Surg. Gynec. & Obst. 108:555 (May) 1959. (*Department of Surgery, Duke University Medical Center, Durham, N. C.)

Plain and chromic gut, silk, cotton, wire, nylon, ramie, Nymo, Dacron, and Teflon were studied in a total of 287 rabbits from the standpoint of tensile strength of the sutured rectus wound, histology of this wound, tensile strength of the implanted suture loop, and grade of tissue reaction to the suture. The gut sutures were similar to the nonabsorbable sutures until absorption began. At this time, the tissue reaction increased and the tensile strength of the suture fell rapidly. The synthetic sutures, and particularly Teflon, caused little tissue reaction and maintained tensile strength well. The tendency for the knot to slip and untie was a disadvantage, but the other favorable characteristics were so decisive that alterations should be sought to produce a dependable knot. The authors also present a review of other comprehensive studies of suture material evaluation.

Industrial Hygiene

Edward C. Riley, M.D.

Health Aspects of Production and Marketing of Chemicals. C. Boyd Shaffer.* A.M.A. Arch. Indust. Health 19:298 (March) 1959. (*Central Medical Department, American Cyanamid Co., New York)

The author reviews the problems associated with the development and marketing of a relatively unknown chemical. He points out the need for teamwork by an industrial toxicologist, physician, and hygienist. Only when the roles of these three professions are fully integrated can an effective preventive health program be achieved.

He states that "any material can be manufactured safely if its economic importance warrants the measures necessary to achieve this. However, there is a toxicity consideration that is even more basic: namely, that economic importance will never materialize if the product cannot be handled and used safely. A decision not to manufacture arrived at for reasons of toxicity occurs with sufficient frequency that it cannot be considered a rarity."

The production and marketing problems of parathion are discussed as an example of a highly toxic product which required extreme control not only during the manufacture but also during the blending and packaging of the insecticide and during use by the ultimate consumers. This was accomplished by an extensive education and training program for all groups concerned, which, in turn, was dependent on a coordination program of industrial health.

Clinical Observations on the Cutaneous Effects Associated with Curing Epoxy Resins. Donald J. Birmingham.* A.M.A. Arch. Indust. Health 19:365 (March) 1959. (*Medical Director and Chief Dermatologist, U.S. Department of Health, Education and Welfare, Public Health Service, Cincinnati)

In this article the author calls attention to the skin hazard associated with handling epoxy-type resins. The application of this type of resin in industry has expanded rapidly in the last few years and this is a most timely discussion. The author lists the following points of contact: (1) mixing the resin with the hardener, (2) molding, (3) solvent-cleaning of tools and protective equipment, and (4) tooling—grinding, drilling, or sanding—the cast or molded laminates. He states that "the major cutaneous effects are produced by contact with the liquid stage of low molecular weight resins or the hardener or with a mixture of these before polymerization or curing is complete. As a general rule the completely polymerized product is inert upon the skin."

Abstracts

Outbreaks of dermatitis can be avoided by following a few basic rules including (1) education about the hazards, (2) adequate ventilation, and (3) personal cleanliness. Eleven specific recommendations are made for control.

[NOTE: We cannot fully agree with the statement that "many of the basic epoxy resins can be handled without offending the skin but most of the amines used as hardeners have an irritant or sensitizing effect." In the reviewer's experience most materials with a free epoxy group are capable of producing sensitivity in a suitable subject.]

Dermatology

William R. Buckley, M.D.

Protective Measures Against Stinging Insects. R. A. Morse* and R. L. Ghent. New York J. Med. 59:1546 (April 15) 1959. (*Department of Entomology, Cornell University, Ithaca, N. Y.)

The authors conveniently divide insects into two broad groups—those that bite, of the order Diptera, and those that sting, of the order Hymenoptera. The former include mosquitoes and biting flies which, in the course of feeding, produce wounds with their mouthparts. This order ordinarily does not produce severe reactions. In addition, repellents may serve as a deterrent because these insects bite to obtain food. The order Hymenoptera contains hornets, wasps, ants, yellow jackets, and bees. These insects may produce severe or even fatal reactions in the human. Repellents are of no value.

Preventive measures to be observed may be summarized as follows: 1. Avoid exposure to insects as much as possible. 2. Wear light-colored clothing with a "hard" or firm finish and keep as much of the body covered as is possible. 3. Avoid using hair oils and perfumes. 4. When attacked by a bee, cover the eyes and face slowly with both hands and remain still: when attacked by a whole nest of hostile bees, leave the area as soon as possible. 5. Remove the stinger from the skin if it can be seen, as soon as possible after the bite.

The Rise in Incidence of Nickel Sensitivity. P. V. Marcussen.* Brit. J. Dermat. 71:97 (March) 1959. (*Department of Dermatology, The Finsen Institute, Copenhagen)

The author points out that few data are available on variations in the incidence of contact dermatitis, sensitization type. In London, Calnan stated that nickel sensitization was the most frequent during 1956. Fisher and Shapiro, during the same year, felt that reactions from nickel were exceeded by those from paraphenylenediamine in the United States.

This study was based on patients with dermatitis in the widest sense seen between 1936 and 1955, who received a routine patch test series comprising 21 materials, including a test with 5% nickel sulfate. In 38,764 routine tests, 727 persons reacted to nickel.

The authors feel that the incidence of nickel sensitivity has risen appreciably over the years. This increase does not appear to be related to sex or occupation; rather it appears to be related to contact with metallic nickel incorporated in articles of clothing. In 1955 nickel sensitivity constituted some 12.9% of all verified sensitivities.

Effect of Carcinogenic Dosage and Duration of Exposure on Skin-Tumor Induction in Mice. W. E. Poel.* J. Nat. Cancer Inst. 22:19 (Jan.) 1959. (*Laboratory of Experimental Carcinogenesis, Department of Occupational Health, Graduate School of Public Health, University of Pittsburgh)

Data are presented which challenge the following hypotheses on tumor development: (1) The chief biologic features of the tumor are delineated at its inception; (2) there is no minimal dose of carcinogen which can be considered innocuous, and (3) once the tumor is initiated, the qualitative change is instantaneous and irreversible.

Reported findings would suggest that the potency of the carcinogen, the length of exposure, and the threshold level are all intimately related to the development of carcinogenesis. The failure of the preliminary hyperplastic skin response to develop into a malignant process once the inciting agent is removed points the need for the "identification and control of carcinogen-induced tissue damage and residual carcinogenic agents in man in order that a practical program of cancer control may be attained."

Skin Eruptions of Workers in a Uranium-Processing Plant. R. L. Kile* and J. A. Quigley, A.M.A. Arch. Dermat. 79:49 (April) 1959. (*2508 Auburn Ave., Cincinnati)

The authors summarize some of the cases of dermatitis occurring in plants processing uranium ore to obtain uranium tetrafluoride. The study was made on 174 cases over a two and one-half year period. Contact dermatitis (36 cases) was by far the leading diagnosis. This resulted from contact with oils, chemicals, defatting agents, etc. Other diagnoses listed, in this small series, were not unusual. None of the cases seen were thought to be due to uranium or its salts. Skin lesions (malignant and some benign) covering small areas were treated by x-rays with good results. Exposures of employees to radiation and chemicals were carefully recorded, but no relationship was established between the skin diseases and the quantity of exposure.

Studies on Melanoma: II. Sex and Survival in Human Melanoma. L. P. White.* New England J. Med. 260:789 (April 16) 1959. (*Department of Medicine, Stanford University School of Medicine, San Francisco)

The term melanoma as used in this paper denotes that malignant tumor arising from the melanoblast and capable of metastasizing throughout the body. An attempt is made by the author to demonstrate certain important features about the behavior of melanomas in the human. A series of 439 deter-

minate cases out of a total group of 871 were studied. There appears to be no difference tentatively between the sexes in terms of delay in diagnosis or in the type of treatment the patient received. Data revealed that the incidence of melanoma was roughly equal in the two sexes. Females with melanoma have a greater chance of survival than males; moreover, females living beyond the five years have a much greater rate of survival than the males. Prognosis in both sexes for five-year survival shows a diminution with advancing age. The effect of pregnancy on melanoma has not been proved statistically to date; however, the adverse effects that may follow pregnancy as well as the better prognosis in the female following five-year survival suggest the possibility of hormonal influence.

Occupational Dermatitis: Its Prevention, with Special Reference to Barrier Substances. R. Porter.* Brit. J. Dermat. 71:23 (Jan.) 1959. (*Research Department, National Leathersellers College, London, S. E. I.)

This study was devised to discover the most suitable barrier cream for the author's particular application. Special tests to study the resilience of the films of barrier substances, their protection against mineral oil, and their pH are outlined. Results of these tests were not encouraging, and the author concludes that prevention of dermatitis cannot be obtained through use of the barrier creams studied.

Internal Medicine

John J. Thorpe, M.D.

The Prognosis in Essential Hypertension. H. S. Mathisen,* D. Jensen, Erling Loken, and Halvor Loken. Am. Heart J. 57:371 (March) 1959. (*Menighetssosterhjemmets Klinikk, Medical Department, Oslo, Norway)

Two hundred ninety patients under age 46 with a maximum systolic blood pressure of 160 mm Hg or more and a maximum diastolic blood pressure of 95 mm Hg or more were registered in several Oslo medical departments prior to 1944. Follow-up studies were conducted on the group on the average of 16 years later. None of these patients received special antihypertensive treatment. Only five patients in the group were lost to follow-up. Ninety-seven of the group demonstrated "labile" diastolic blood pressure, i.e., the diastolic blood pressure fell below 95 mm Hg after rest or sedation. Only 7 (13%) of the 54 women and 12 (28%) of the men in this group died during the observation period. This approximates the death rate in the general population of the same age and sex distribution. In the remainder of the group, with "stabilized" diastolic blood pressure 95 mm Hg or more, 64 (54%) of 123 women and 48 (75%) of 64 men died. This is approximately five times the death rate in the groups with "labile" hypertension. Fifty-five per cent of the deaths in the total study were due to cerebral causes, 24% were due to cardiac causes, and 12% were due to renal failure. The higher proportion of cerebral deaths in this group compared with those in other studies in the literature is ascribed to the fact that the average age of the group (38 years) was lower than in groups previously reported.

Angina Pectoris: II. Observations on the Classic Form of Angina Pectoris (Preliminary Report). M. Prinzmetal,* Alfred Goldman, Herbert Shubin, Naci Bor, and T. Wada. Am. Heart J. 57:530 (April) 1959. (*Institute for Medical Research, Cedars of Lebanon Hospital, Los Angeles)

Clinical and electrocardiographic differences between "classical" and "variant" forms of angina pectoris are discussed. Experimental studies by epicardial ECG leads in 15 patients undergoing the Beck procedure for angina pectoris and in animals with controlled lowering of the systemic blood pressure are described. In patients with "classical" precordial pain on effort or excitement relieved by rest and ECG changes of ST segment depression in standard and precordial leads, scattered "islands" of ST segment depression were found over both ventricles. There was no observed anatomic difference between these "islands" and adjoining epicardium. The diffuse nature of the process explained the lack of reciprocal ST segment elevation. In animals with experimental narrowing of one large coronary artery, cyanosis of a portion of the myocardium supplied by the vessel was observed and ST segment elevation with reciprocal depression was observed. The "island" phenomenon was not present. These findings were similar to those in patients with "variant" anginal complaints. Additional experiments are described which indicate that, contrary to current theory, the ST segment changes are due to disturbances in the outer myocardial layers rather than the subendocardium. The occurrence of localized ST segment elevation in "variant" angina makes prediction of the site of future infarction possible.

Rheumatic Fever in the Adult: Criteria and Implications. Charles K. Friedberg.* Circulation 19: 161 (Feb.) 1959. (*New York City)

Rheumatic fever in adults over 25 years of age is often overdiagnosed, in the author's experience. This overdiagnosis is usually due to a failure to adhere to diagnostic criteria, such as those proposed by The Council on Rheumatic Fever, or to realize the limitations of so called major and minor criteria. In adults, the three most distinctive and specific major criteria, i.e. chorea, subcutaneous nodules, and erythema marginatum, are usually absent. This leaves only arthritis and carditis as bases for diagnosis. Arthritis in rheumatic fever is by no means specific and is often identified on the basis of exclusion.

Carditis in the adult is not identified without difficulty. The common practice of accepting an apical systolic murmur or a change in such a murmur as indicating rheumatic fever is viewed critically in view of the subjective interpretation in-

volved. Diastolic murmurs, on the other hand, almost always indicate preceding rheumatic fever. Pericarditis has lost its specificity in recent years owing to the rise in idiopathic pericarditis. Progressive cardiac enlargement and congestive heart failure are not the reliable indicators of rheumatic disease in the adult over 25 compared to the younger age group. In the author's experience, an initial attack of rheumatic fever after 25 is rarely if ever followed by significant heart damage. He is also skeptical of many instances of progression of rheumatic heart disease diagnosed on the appearance of fever.

Until the evidence is more conclusive, diagnoses of initial attacks of rheumatic fever in adults over 25 should be made with caution. The serious prognosis, the limitation of activity, and the need for prophylaxis associated with childhood rheumatic fever do not appear warranted in this older group.

High Voltage QRS Complexes in the Absence of Left Ventricular Hypertrophy. G. R. Cumming* and W. C. Proudfit. Circulation 19:406 (March) 1959. (*Department of Cardiovascular Disease, Cleveland Clinic Foundation)

Electrocardiograms on 143 patients at the Cleveland Clinic were analyzed according to the criteria for left ventricular hypertrophy proposed by Sokolow and Lyon. The results were then correlated with the clinical evidences of hypertrophy obtained by review of the patients' charts and radiologists' reports of heart size. Where the first criterion of hypertrophy (combined voltage of $SV_1 + RV_5$ in excess of 35 mm) was tested, 39% of the patients had no clinical evidence of hypertrophy, 45% had definite hypertrophy, and 16% were borderline. Testing of the second criterion (R_aV_L in excess of 11 mm) yielded a somewhat better correlation, with 29% showing no hypertrophy, 53% definite hypertrophy, and 18% borderline changes. In the small number of cases (15) in which both of the above criteria were positive, correlation was greatly improved, 93% showing definite hypertrophy and 7% borderline clinical evidence of this change.

The authors conclude that the voltage indices for left ventricular hypertrophy presented by Sokolow and Lyon are useful and easy to apply, but the lack of specificity of voltage changes seriously limits their clinical application.

Electrocardiographic Response to Exercise in Patients with Mitral Stenosis. L. H. Ramsey* and John Beeble. Circulation 19:424 (March) 1959. (*Vanderbilt University School of Medicine, Nashville, Tenn.)

Forty-eight patients with rheumatic mitral valvular disease were studied by means of the standard single Masters Two-Step Test. Fourteen of the patients were receiving digitalis medication. A positive response was obtained in 40% of the Class I, 76% of the Class II, and 100% of the Class III patients tested. The relative percentages remained unchanged when the group taking digitalis was compared with the nontreated group.

The authors suggest that myocardial ischemia during exercise is the cause of these electrocardiographic changes. Elevated pulmonary arterial pressure and increased heart rate raise the relative oxygen demand of the heart muscle, but the cardiac output and systemic blood pressure fail to rise proportionately. These factors may well result in a decrease in diastolic perfusion time and effective perfusion pressure of the coronary circulation when the cardiac work-load is greatest.

Clinical Toxicology

Lee H. Miller, M.D., I.M.D.

Talc Pneumoconiosis. A. O. Seeler,* J. S. Gryboski, and H. E. MacMahon. A.M.A. Arch. Indust. Health 19:392 (April) 1959. (*Mount Auburn Hospital, Cambridge, Mass.)

The case histories and postmortem findings of two of three men each of whom had a diagnosis of talc pneumoconiosis are presented. Each of the men worked for approximately 25 years or more as "lay up" men in a factory that manufactured rubber-coated cable. Their work consisted of shoveling talc, hydrous magnesium silicate [$H_2Mg_3(SiO_3)_4$], into pans and coiling the rubber-coated cable on the layer of talc. Ninety per cent of the talc particles were less than 10 μ in size. The free silica content was stated to be less than 0.5%. The talc contained little or no tremolite.

The symptoms and physical findings that were observed in both cases were of the type seen frequently in severe chronic pulmonary disease. The chest x-ray films revealed evidence of extensive fibrosis bilaterally, exaggerated linear markings, and emphysematous blebs or bullae. At postmortem examination, many dense pleural adhesions were found. The lungs were inelastic, nodular, heavy, and deeply pigmented and exhibited much scarring. The hilar, paratracheal, and tracheal bronchial nodes were enlarged, firm, and heavily pigmented. Histopathologic examination of the lung tissue revealed a progressive replacement of normal lung parenchyma by fibrous tissue. Narrowing and occlusion of bronchi and bronchioles and obliteration of many vascular and lymph channels were noted. Patches of emphysema and atelectasis were present. Many birefringent needle-shaped particles (believed to be talc as a result of x-ray diffraction studies) were present in the areas of fibrosis. "Talc bodies" were not found.

The authors conclude that talc must be regarded as a material that will cause pneumoconiosis if a high concentration of the dust is inhaled for many years. The article is illustrated with numerous photomicrographs and x-ray reproductions.

Histochemical Proof of Organic Phosphate Poisoning. C. S. Petty.* A.M.A. Arch. Path. 66:458 (Oct.) 1958. (*Department of Pathology, Louisiana State University School of Medicine)

Since the organic phosphates combine more or less irreversibly with the cholinesterases of the

body, it would be expected, in fatal cases, that the cholinesterase levels of tissues that are removed at autopsy would be either reduced considerably or not demonstrable. Previous work by Bergner et al. suggested that the histochemical demonstration of true cholinesterase activity at the myoneural junction of skeletal muscle might be a valid way to prove that death resulted from organic phosphate poisoning.

The history and clinical findings of a 25-year-old white man who died as a result of poisoning with Systox (an insecticide concentrate that contained, as the principal active agent, 26.2% O,O-diethyl-O-2-ethylmercaptoethyl thiophosphate) is reviewed. Blood from the heart was analyzed for anticholinesterase activity, and histochemical studies of intercostal muscle to demonstrate the presence or absence of cholinesterase were carried out. The latter studies consisted of staining the true cholinesterase at the myoneural junction. With the method that was used, the active cholinesterase was indicated by a brown precipitate in the region of the motor end-plate. The red blood cell cholinesterase activity was 0.38 μM. of acetylcholine utilized under the conditions of the experiment. This level was highly suggestive of organic phosphate poisoning. Pale staining in the region of the motor end-plates of the muscle specimen indicated cholinesterase activity that was much less than normal. A similar finding was also demonstrated in a rat that was poisoned with Systox. The author believes that this method may be useful to examiners who wish to establish the cause of death in accident or other cases that may be related to organic phosphate poisoning.

Criminal Thallium Poisoning. R. Matthys* and F. Thomas. J. Forensic Med. 5:111 (July-Sept.) 1958. (*Department of Legal Medicine and the Neuro-Psychiatric Clinic of the University of Ghent, Ghent, Belgium)

The incidence of thallium poisoning has increased considerably in Belgium since the introduction of rodenticides that contain this element.

In acute or subacute cases, the first signs are gastrointestinal or neurological. Nausea and vomiting accompanied by violent colics occur within a few hours after ingestion. Diarrhea may occur sometimes; however, extreme constipation develops in all cases and the clinical picture may simulate intestinal obstruction. With small doses, the gastrointestinal symptoms may be quite mild. Within a few hours to a couple of days, violent pains in the distal portions of the limbs, and, particularly, the big toe (gout is simulated), are experienced as a result of the development of polyneuritis. The sensory phenomena are described by patients as "frozen limbs, frozen feet, feeling as though the legs were enveloped in wet felt, or laid on glass splinters, or as if the toes were being cut off." The paresthesias begin in the feet and ascend toward the trunk. The same sensory disturbances develop in the hands, to a lesser degree, before the trunk is involved. This is followed by motor disturbances of the limbs manifested by muscular weakness, paresis, or complete paralysis of the lower extremities. The deep reflexes may be increased initially but disappear later. Toxic neuritis of the phrenic nerve and other branches of the cervicobrachial plexus may cause difficult breathing. The most striking feature is the massive loss of the hair of the scalp, which generally occurs between the 14th and the 18th day. The outer two-thirds of the eyebrows are lost, and the pubic and axillary hair may fall out. Abundant regrowth of hair occurs in about a month. Transverse narrow white lines may appear in the nails in about eight weeks.

Thallium salts are very soluble and are eliminated within a few days to a few weeks. Consequently, it is advised that spectrographic or polarographic techniques should be used for their detection in biologic specimens. Several case reports with photographic illustrations are presented.

Petrol-Vapour Poisoning. R. Aidin.* Brit. M. J. 2:369 (Aug. 9) 1958. (*Worthing Hospital, Worthing, England)

Despite the widespread use of petrol (gasoline), deaths from inhaling petrol vapors are rare. Consequently, there is a paucity of information concerning the concentrations that may be fatal to man after a short exposure. A review by Machle is cited in which he records that men exposed to a concentration of 1,000 ppm for 15 minutes exhibited central nervous system signs and symptoms which included drowsiness, dullness, and numbness. After an exposure of one hour, vertigo, ataxia, and slight nausea were present. Exposure to a concentration of 3,000 ppm caused symptoms to appear much more quickly, while exposure to 7,000 ppm caused intoxication in five minutes. Machle noted that a concentration of 10,000 ppm was fatal to experimental animals.

The circumstances surrounding a fatal case are recounted. On a hot day, a 17-year-old youth was sent to obtain some petrol which was stored in a 40-gallon metal drum that was located within a poorly ventilated hut. To obtain the petrol, he apparently had to bend his head and shoulders into the drum. He was found dead 45 minutes later, with his head, shoulders, and arms slumped over the edge of the drum. At necropsy, the esophagus and trachea contained regurgitated stomach contents. No other significant abnormalities were observed. An odor of petrol was not noted from the lungs. The lungs, liver, heart, and kidneys had a normal appearance microscopically. When the operation was carried out on the following day, it was found that the petrol-vapor concentration in the drum (15 seconds after the lid was removed) was 25,000 ppm. During the 80 seconds required to fill the can with petrol, the concentration of petrol vapor varied from 8,000 to 35,000 ppm, averaging 20,000 ppm. The con-

centration of petrol vapor three ft. from the drum, four minutes after the lid had been removed and one minute after it had been replaced, was 2,500 ppm. As a result of these determinations and the findings at necropsy, it is concluded that death resulted from the inhalation of petrol vapor.

Experimental Toxicology

Robert E. Eckardt, Ph.D., M.D.

Effect of Carbon Blacks on Carcinogenic Compounds. E. von Haam,* H. L. Titus, I. Caplan, and G. Y. Shinowara. Proc. Soc. Exper. Biol. & Med. 98:95 (May) 1958. (*Ohio State University, Columbus)

Quantitative determinations are presented on the extent of adsorption of 20-methyl cholanthrene, 3,4-benzpyrene and *p*-dimethylaminoazobenzene by seven different carbon blacks. Administration of carbon black alone by feeding, painting, and subcutaneous injection did not produce any benign or malignant tumor in 460 animals. Only 1 of 72 rats fed *p*-aminoazobenzene adsorbed on three carbon blacks developed a hepatoma, compared with 58% tumors in the group fed identical dosages of the azobenzene alone. In skin-painting studies the positive control of 3,4 benzpyrene induced tumors in 96% of the animals. When adsorbed on five carbon blacks tumors appeared in 54% to 69% of the mice. It is believed that elution of the carcinogen by the acetone or olive oil used as solvent was responsible for the tumor production, since when the carbon-black-containing adsorbed carcinogen was was rubbed into the skin without solvent, no tumors were induced, compared with 12% tumors in mice treated with dry carcinogen alone. Sarcoma induction in rats by subcutaneous injection of 20-methylcholanthrene adsorbed on three carbon blacks was about the same as that observed with the positive control, although one suspension did induce fewer tumors. Again, the tumor induction is attributed to the eluting effect of the olive oil.

Toxicological Studies on Hydrocarbons: III. The Biochemorphology of the Phenylalkanes and Phenylalkenes. H. W. Gerarde.* A.M.A. Arch. Indust. Health 19:403 (April) 1959. (*Esso Research & Engineering Co., Linden, N. J.)

The toxicology, biochemistry, and metabolism of the alkyl derivatives of benzene are summarized. Sources, industrial uses, and physical properties of the compounds are also discussed. Benzene remains unique with respect to myelotoxicity, and to avoid semantic association of its alkyl derivatives with this specific toxic effect, the term "phenylalkane" is suggested as a substitute for "alkyl benzene."

Encephalitis Induced by Sodium Fluoride Intoxication in Experimental Animals. Chin-Tang Yu, Ying-Han Hsu, and Ding-An Lou. Chung Hau I Hsueh Tsa Chih 43:777, 1957; Chem. Abst. 53: 4585i (March 10) 1959. Chekiang M. Coll., Hangchow)

Development of acute and chronic encephalitis from fluorine intoxication was confirmed in 38 rabbits and 30 mice. The ganglion cells in the anterior horn of the spinal cord of every animal showed marked degeneration. Immediate administration of calcium gluconate to form CaF_2 effectively prevented encephalitis. Ca gluconate lost its effectiveness once the F ions were absorbed by the digestive system. CaF_2 caused contracted kidneys in most animals.

Tumor Promoting Effect of Fatty Acids in the Skin of Mice. P. Holsti.* Naturwissens. 45:394, 1958; Chem. Abst. 53:4517b (March 10) 1959. (*University of Helsinki)

After a single cutaneous treatment of albino mice with a 0.3% solution of 9,10-dimethyl-1,2-benzanthracene (DMBA) in paraffin oil, different fatty acids were painted on the skin once daily six days a week for 24 weeks. Controls received DMBA only, and no skin tumors appeared. The tumor rate with undiluted oleic acid was 56, with 20% oleic acid in $CHCl_3$ 32, with 20% lauric acid in $CHCl_3$ O, with 20% palmitic acid in $CHCl_3$ O, with $CHCl_3$ O, and with Tween 60 52%. More tumors occurred in males than in females.

Induction of Sarcoma in the Rat by Iron-Dextran Complex. H. G. Richmond.* Brit. M. J. 1:947 (April 11) 1959. (*University of Aberdeen, Scotland)

Between the 11th and 16th months of treatment, 16 of 23 adult rats surviving weekly intramuscular injections of 0.4 ml iron-dextran complex (20 mg. Fe as $Fe[OH]_3$) developed pleomorphic histiocytic sarcomas at the site of injection. Attempts to repeat this effect with saccharated iron oxide failed because injection schedules were interrupted owing to necrosis and ulceration. Tumors also developed in 22 of 40 weanling rats dosed biweekly with the complex (total 9.5 ml) six to eight months after cessation of treatment. No tumors were observed in rats dosed only with dextran or normal saline solution. Metastases did not occur in tumor-bearing rats, but transplantation was successful, the growth being essentially spindle-cell sarcoma. A possible relationship between the carcinogenicity of Fe as described and the high incidence of hepatoma in liver cirrhosis associated with hemachromatosis is discussed. The results of these experiments also suggest that Fe may be an important causal factor in pulmonary carcinoma in hematite miners.

Appraisal of the Safety of Chemicals in Foods, Drugs and Cosmetics. Food & Drug Administration, Division of Pharmacology.* Food & Drug Officials U. S., 1959. (*Baltimore, Md.)

Chapters are authored by various members of the Pharmacology Division staff outlining the FDA's experimental program for evaluating the safety of chemical components (intentional or incidental) of foods, drugs, and cosmetics. Chapters

pertinent to food chemicals include the following: chemical criteria and analytical considerations; acute, subacute, and chronic oral toxicity tests; dermal toxicity tests; biochemical studies; carcinogenicity screening studies; pathology studies; statistical analysis of data; and some interpretative problems in evaluating the safety of food additives. (A table gives the approximate relation of ppm in diet to mg/kg/day for various species ranging in size from the mouse to the horse.)

Fatty Alcohol Films and Water Evaporation Control. A. Food & Drug Officials United States 22:168 (Oct.) 1958.

Biochemical studies on hexadecanol and octadecanol have shown them to be normal intermediates in fat metabolism, and that they will not present any health hazards if used as monomolecular films on pond and reservoir surfaces to control evaporation of potable water supplies.

Metabolism of 1,1,1-Trichloroethane by the Rat. C. L. Hake,* T. B. Waggoner, and V. K. Rowe. Fed Proc. 18:399 (March) 1959. (*Dow Chemical Co., Midland, Mich.)

A metabolism study was carried out to determine the cause of the comparatively low toxicity of 1,1,1-trichloroethane to animals and humans, reported by Torkelson and Co. workers in the American Industrial Hygiene Association Journal *(19:* 353, 1958). 1,1,1-Trichloroethane-1-C^{14} was injected intraperitoneally into rats, and balance studies were carried out after each animal had spent 25 hours in a metabolism chamber. Expired air analysis showed that 97.6% of the labeled material was expired unchanged, while 0.5% was converted to $C^{14}O_2$. Only trace amounts of activity remained in the animal. Urine specimens contained 0.5 to 1.0% of injected activity.

Chemical Injury of the Hemopoietic System Induced by Epoxy Alkylating Agents. J. K. Kodama,* R. J. Guzman, C. H. Hine, and H. H. Anderson. Fed. Proc. 18:411 (March) 1959. (*University of California, San Francisco)

A series of epoxy compounds was investigated for possible radiomimetic activity against the hemopoietic system. Of the 13 epoxides tested by repeated injection of rats, glycidyl aldehyde, allyl glycidyl ether, triglycidyl phosphate, vinylcyclohexene diepoxide, and EPON 562 produced severe toxic effects at doses used. Epoxides with polyfunctional groups were more active than monofunctional epoxides. Triglycidyl phospate and glycidyl aldehyde were more selective in cytotoxic action against bone marrow than against lymphoid tissue, whereas allyl glycidyl ether acted conversely. Anemia developed as early as four days with glycidyl aldehyde, allyl glycidyl ether, vinylcyclohexene diepoxide, and EPON 562, and was suggestive of an increased rate of erythrocyte destruction. Repeated cutaneous application or vapor inhalation of certain compounds also produced definite toxic effects and depression of the hemopoietic system. The radiomimetic potency of the biologically active epoxides could be categorized between the nitrogen mustards and benzene.

Radiation Health

Thomas S. Ely, M.D.

Iodine-131 in Human Thyroids Following the Windscale Reactor Accident. G. Maycock* and J. Vennart. Nature, London 182:1545 (Dec. 6) 1959. (*Radiological Protection Service, Belmont, Sutton, Surrey, England)

In October, 1957, after the Windscale incident, the detection of a greater than expected body radioactivity in some individuals, which was later identified as iodine-131, led to a program of determination of this isotope in human thyroids. Eighteen persons were measured. Most of the subjects were residents of, and drank milk from, the Greater London area which was contaminated following the Windscale cloud passage. The results indicate that several millimicrocuries of iodine-131 were absorbed by the thyroids of these persons. The calculated thyroid dose to the average person in Surrey and London was 0.04 rad. Multiple determinations demonstrated a decay rate in the thyroids less than the physical, indicating an intake extended in time.

Radioactivity Due to Fission Products in Biological Material. W. V. Mayneord,* W. Anderson, R. E. Bentley, L. K. Burton, J. O. Crookall, and N. G. Trott. Nature, London 182:1473 (Nov. 29) 1958. (*Physics Department, Institute of Cancer Research, Royal Cancer Hospital, London)

Measurements of radioactivity of cow and human milk in South Wales were made over a period which included the Windscale incident. Chemical separation followed by beta counting and gamma scintillation spectrometry permitted the determination of strontium-89, strontium-90, iodine-131, cesium-137, and potassium-40. A transient increase in iodine-131 and cesium-137 but not strontium-90 was found following the Windscale accident. The levels of strontium-90 remained relatively constant, but the strontium-89, strontium-90 ratio changed considerably over the period of measurement.

Electronic Data Processing and Radiation Exposure Records. I. C. Nelson. Health Physics 1:345 (Dec.) 1958. (*Hanford Laboratories Operation, General Electric Company, Richland, Wash.)

At the Hanford Atomic Products Operation, radiation exposure records are processed on about 14,000 people annually. Most of the records come from film badge dosimeters changed on a biweekly schedule, resulting in about a quarter of a million processed per year. An electronic data processing system has been set up around an IBM 702 machine, which permits more rapid data handling with fewer people. Another effect is increased flexibility

of operation, permitting such benefits as automatic production of reports, preparation of bioassay labels and analytical sheets, and reduction of the data to tape form for storage in minimum volume. Even a program of this size would fall far short of justifying an IBM 702, but where one already exists computer time can profitably be spent in this application.

The Liver, Radiation and Leukemia. M. F. Beard.* Am. J. Roentgenol. 81:504 (March) 1959. (*University of Louisville School of Medicine, Louisville, Ky.)

Leukemia is likely to follow ionizing radiation, as shown in studies on radiologists, Japanese atomic bomb victims, and radiation therapy patients. Biochemical and filterable agent etiology have been proposed. This study has demonstrated an increased protein-bound vitamin B_{12} content of serum in cases of nonlymphatic leukemia. Normal values range from 86 to 460 μg per milliliter and abnormal values from 1,000 to 9,200 microgamma per milliliter. Vitamin B_{12} is bound to alpha-globulin, which is produced in the liver. Nonlymphatic leukemia alpha-globulin is apparently abnormal in that it has a greatly increased capacity for binding the vitamin. Since vitamin B_{12} stimulates the production of nucleoproteins, it is proposed that chronic radiation damage of the liver causes production of abnormal alpha-globulin, which binds excess vitamin B_{12} which then stimulates abnormal production of nucleoproteins, leading to leukemia.

The Relative Hazards of Strontium 90 and Radium 226. M. Hindmarsh,* M. Owen, J. Vaughan, L. F. Lamerton, and F. W. Spiers. Brit. J. Radiol. 31: 518 (Oct.) 1958. (*Nuffield Department of Medicine, Oxford, England)

The radiation dose to the skeleton from strontium-90 or radium-226 is spatially nonuniform, not only because of the effective range of the respective radiation, but also because of the distribution of the nuclide within the bone. Age and length of uptake influence the uniformity, since there is a continual deposition and absorption of mineral elements in bone. Radium is deposited in the Haversian systems, endosteal and periosteal bone, and calcified epiphyseal cartilage. Strontium distribution is assumed to be similar. The range of radium alpha particles is about 35 μ in bone, which is less than the shortest dimension of the observed deposits. The strontium-90 beta particle has a maximum range of about 6 mm in bone, and, thus, for a similar distribution would produce more even radiation. Models were set up permitting the calculation of doses and dose uniformity for various assumptions. The "dosage nonuniformity factor" for radium was calculated to be as high as 16, while that for strontium-90 was not higher than 3.1, based on the concentrations observed in a case of radium deposition. A maximum permissible level for strontium-90 can be derived from a comparison with the established radium level, or from consideration of the dose to the bone. Both methods introduce the uncertainties of assumptions, not the least of which is the relative biological effectiveness.

Applications of an Analog Computer to Analysis of Distribution and Excretion Data. B. R. Fish.* Health Physics 1:276 (Dec.) 1958. (*Health Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tenn.)

The work of the ORNL Health Physics Division is studying various mathematical models for the distribution and excretion of uranium following intravenous injection has been greatly facilitated by the use of an electric analog computer. A four-compartment linear model appeared to be adequate to explain data obtained from male rats and low-dose level human data. However, to simulate human excretion following injection at higher dose levels, it was necessary to superimpose a saturable excretion pathway upon the linear model. A prime object of the model work has been the derivation of some means whereby field measurements of excretion may be related to internal dose. That object has been realized in the inverse model by comparing the model output with the excretion data to obtain an error function which is used to drive the model. [AUTHOR'S ABSTRACT]

Diagnostic and Therapeutic X-radiation in an Urban Population. A. M. Lilienfeld.* Public Health Rep. 74:29 (Jan.) 1959. (*The Johns Hopkins School of Hygiene and Public Health, Baltimore)

In 1956, a 1 in 75 uniform sample of Buffalo, N. Y., residents over 17 years old was interviewed with respect to diagnostic radiography during the previous 12 months and lifetime therapeutic radiation. Insufficient data were obtained to arrive at any radiation dosage estimate, but it was demonstrated that exposure frequency can be correlated with several factors. It was found that about half of the population had had diagnostic examinations in the previous year, but more men than women, more nonwhites than whites, more upper socioeconomic group than lower socioeconomic group, more younger than older, and more Jews than non-Jews. Therapeutic radiation had been received during the lifetime of about 8% of the white persons and 2.5% of the nonwhite persons interviewed, with more women than men, more upper socioeconomic group than lower socioeconomic group, and more Jews than non-Jews. Although there is positive correlation between these facts and the leukemia rates in similar groups, more and further refined data would be needed to conclude significance.

About the Authors

JOHN W. DITZLER, M.D., is Assistant Director of the Department of Anesthesiology, Henry Ford Hospital, Detroit. He is a native of Maryland, and was educated at Gettysburg College and Temple University. He received the M.D. degree from the latter institution in 1944. Dr. Ditzler served residencies in anesthesiology at the Veterans Administration Hospital in Pittsburgh and at the Hospital of the University of Pennsylvania. Before joining the staff at Henry Ford Hospital, Dr. Ditzler was chief of Anesthesia at Valley Ford Army Hospital. He is senior author of "Brachial Plexus Block for Hand Surgery—Experience at Henry Ford Hospital," the lead article of this issue.

ROBERT H. CLIFFORD, M.D., coauthor of the article in this issue, "Brachial Plexus Block for Hand Surgery Experience at Henry Ford Hospital," recently died suddenly while attending a surgical meeting in Boston. He was a specialist certified by the American Board of Plastic Surgery, fellow of the American College of Surgery, and a member of the American Association of Plastic Surgery, American Society of Plastic and Reconstructive Surgery, and American Society for Surgery of the Hand. He practiced plastic surgery at the Henry Ford Hospital, Detroit, and was an active member of the Wayne County Medical Society.

WILLIAM B. DEICHMANN, Ph.D., is senior author of the article "Effects of Microwave Radiation on Experimental Animals," which appears in this issue. Since 1953 Dr. Deichmann has been Chairman and Professor of Pharmacology, the University of Miami School of Medicine. He and his associates are actively engaged in the solution of toxicology problems for a list of major industries as well as for branches of the armed forces.

Dr. Deichmann was awarded the Ph.D. degree by the University of Cincinnati in 1939 and for the following 10 years was head of a division of toxicology at Kettering Laboratory. There followed three years as associate and as Professor of Pharmacology at Albany Medical College, after which he made the move to Miami. Earlier in his career he was an assistant in biochemistry at Western Reserve University, and a junior pharmacologist at the Du Pont Company's Haskell Laboratory.

Associated with Dr. Deichmann in this presentation are Mr. Frank H. Stephens Jr. and Drs. M. L. Keplinger and Kenneth F. Lampe. Mr. Stephens holds the B.S.E.E. degree from the University of Miami, where he now is Chief Engineer of the Radar Research Laboratory and a consultant to the Department of Pharmacology. Dr. Keplinger in 1956 received the Ph.D. degree from Northwestern University Medical School, where he was a lecturer in pharmacology until he went to the University of Miami as Research Assistant Professor of Pharmacology in 1956. Dr. Lampe holds the Ph.D. degree from the State University of Iowa. After a year of postdoctoral research at Yale University he joined the Miami group as Associate Professor of Pharmacology in 1954.

FREDERICK H. SHILLITO, M.D., is author of the article "Preparation for Retirement," in this issue. A native of Michigan, he apparently yielded to a homing drive, and, after a career of major accomplishments in the east, returned in 1958 to serve as the University of Michigan's Associate Director, Institute of Industrial Health, and to accept associate professorships in industrial health and internal medicine.

Dr. Shillito received the A.B. degree from the University of Michigan in 1927 and the M.D. degree from Harvard Medical School in 1931. After this he interned at Peter Bent Brigham Hospital in Boston. From 1933 to 1958 he was continuously on

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About the Authors

the staff at Columbia Presbyterian Medical Center, New York, in the Department of Internal Medicine. His interest in industrial medicine started in 1935 when he began investigations of carbon monoxide poisoning. Concurrently with his appointment in internal medicine, he was Assistant Professor of Industrial Medicine in the School of Public Health of Columbia University, from 1939 to 1941; and, for about the next 10 years, he was Medical Director, Atlantic Division, Pan American World Airways. Prior to his move to Ann Arbor, he was Medical Director of the American Can Company.

Dr. Shillito is the author of some 20 published scientific articles. He is certified by the American Board of Internal Medicine and (in Occupational Medicine) by the American Board of Preventive Medicine.

LEMUEL C. MCGEE, M.D. is this year's recipient of the IMA Knudsen Award "for the most outstanding contribution to industrial medicine." A remarkable feature of his selection for this honor is the circumstance that, so far as we are aware, he is the first recipient who has not limited his practice to industrial medicine. Dr. McGee is an internist with an active practice in Wilmington, Delaware, who at the same time is Medical Director of Hercules Powder Company. His duality of practice is underscored by certification by two specialty groups, the American Board of Internal Medicine and the American Board of Preventive Medicine.

After receiving the A.B. degree from Baylor University in 1924, Dr. McGee entered the University of Chicago, where in five years' time he earned both the Ph.D. and the M.D. degree. After hospital training he began a practice in internal medicine at Dallas, Texas, and served part time as an instructor in physiology and pharmacology at Baylor. He then served for four years as Chief of Internal Medicine, Golden Clinic, Elkins, West Virginia. This was followed by a year of research and study at Peter Bent Brigham Hospital, Boston, and in 1940 the move to Wilmington.

Dr. McGee's graduate work and research have given emphasis to biochemistry and physiology. His academic performance won for him memberships in Sigma Xi and Alpha Omega Alpha societies. He is the author of about 70 papers published in professional and scientific journals, and a textbook entitled, "A Student Manual of Industrial Medicine," which has had three editions. His contribution to this issue of our JOURNAL is the article "Some Practical Aspects of Disability Evaluation."

Captain CHRISTOPHER C. SHAW, Medical Officer of the Philadelphia Naval Shipyard and Philadelphia Naval Base for the past four years, is representative of the type of men contributing to the significant achievements scored by the Navy in the field of medicine during recent years. He is senior author of the article, "Occupational Medicine in the Navy." A graduate of Yale College and the University of Maryland Medical School, Capt. Shaw joined the Naval Reserve in 1940 and served on active duty during the war as a member of the staff of the U. S. Naval School of Aviation Medicine, Pensacola, Florida, and as Flight Surgeon aboard the USS *Solomons* for two years during the Battle of the Atlantic. From 1945 to 1946 he was Educational Director of the American College of Physicians, with headquarters in Philadelphia, and from 1946 to 1948 he served as Assistant Director of the Medical Research Laboratory of Sharp and Dohme, Inc. (now Merck, Sharp and Dohme). In 1948, Capt. Shaw transferred to the regular Navy and was assigned duty in the Bureau of Medicine and Surgery. From 1950 to 1952 he served as Director of the Research Division, Bureau of Medicine and Surgery, Navy Department.

Dr. Shaw was awarded the Sir Henry Wellcome Medal in 1954 by the Association of Military Surgeons of the United States for his research on the

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artificial kidney performed at the Metabolic Research Facility, U. S. Naval Hospital, Oakland, Calif., where he served as Chief of Medicine for two years. In addition to his current post, Capt. Shaw is an assistant professor of medicine at the Hahnemann Medical College and Hospital and an associate in medicine on the faculty at the University of Pennsylvania Medical School.

He is a member of the American Medical Association, the American Association for the Advancement of Science, a Fellow of the American College of Physicians, and a Fellow of the American College of Cardiology. In June, he was selected to membership in the American Academy of Occupational Medicine. He has been certified as a specialist by the American Board of Internal Medicine (1939), subspecialty in Pulmonary Diseases (1954), and the American Board of Preventive Medicine, Section on Aviation Medicine (1958).

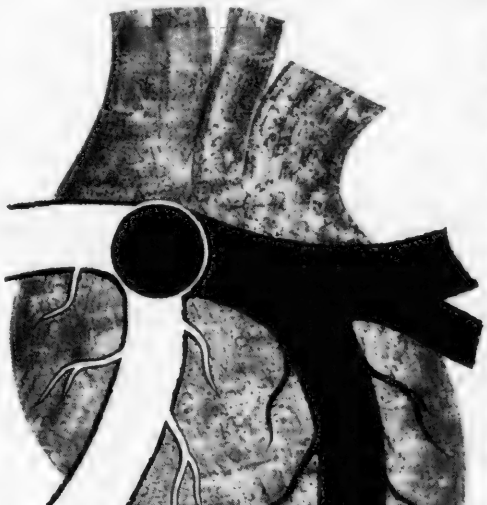
Capt. GLENN D. HUTCHINSON is senior medical officer at Mare Island Naval Shipyard, Vallejo, Calif., a post he has filled since 1957. His primary duty on this assignment is the occupational health maintenance of employees and other personnel engaged in the construction and operation of nuclear reactors in submarines. He is co-author of the article "Occupational Medicine in the Navy," appearing in this issue.

Dr. Hutchinson's entire professional career has been devoted to occupational medicine. At the conclusion of his hospital training in 1937, he became industrial medical director for Combined Metals Company, a subsidiary of National Lead Company. His naval service began in 1942 and has been continuous since that date. In his first appointment he was Officer in Charge of the occupational health program at Mare Island, to which post he returned briefly in 1947-1948, and now occupies again. Other service posts have been at Puerto Rico, Pearl Harbor, Boston, Philadelphia, and Mechanicsburg (Pennsylvania). For a three year period, 1951-1954, he was head of the Division of Industrial Medicine in the Bureau of Medicine and Surgery, Department of the Navy.

Dr. Hutchinson received his academic and medical education at the University of Nebraska, graduating with the M.D. degree in 1936. Thereafter he served a rotating internship and a one-year residency in surgery at Bishop Clark Memorial Hospital, Omaha. His formal postgraduate training has, besides, included a course in orthopedic surgery at the University of California; courses in industrial hygiene and industrial medicine at Columbia University and California; and Navy service courses in radiological defense and special weapons.

Dr. Hutchinson is certified in Occupational Medicine by the American Board of Preventive Medicine and is a member of the Industrial Medical Association.

BERTRAND E. BENNISON, M.D., is Assistant Director of the Medical Research Division of the Esso Research and Engineering Company. His article in this issue, "Hypoglycemic Agent Toxicity," was originally prepared for distribution to physicians of companies affiliated with Standard Oil Company (New Jersey). Dr. Bennison did his undergraduate study at Massachusetts Institute of Technology and received medical training at Harvard Medical School. After an internship, he entered the United States Public Health Service and was stationed at the National Institutes of Health, working during the war years on malaria and later on cancer. A field assignment in tuberculosis control activities completed, he attended the Graduate School of Public Health of the University of Pittsburgh and received his M.P.H. degree in 1954. He is certified by the American Board of Preventive Medicine and participates in the teaching program of New York University Post-Graduate Medical School.



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—Early Management of Myocardial Infarction: **B. E. Pollock; Journal of the American Medical Association, 161:404 (June) 1956.**

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People and Events

► IRVIN KLEIN, M.D. has been appointed Medical Director of the New York State Workmen's Compensation Board. DR. KLEIN, who has been an Associate Examining Physician of the Board since 1942, succeeds WILLIS M. WEEDEN, M.D.

In his new capacity DR. KLEIN will head a staff of 51 physicians throughout the State whose responsibilities include the medical examination of injured workmen who are claimants under the Workmen's Compensation Law, to ascertain the extent and effect of the injuries.

DR. KLEIN completed his undergraduate studies at George Washington University. He received his medical degree from New York Medical College in 1933, and has been an instructor in medicine there since 1935. He served his internship at Coney Island Hospital from 1933 to 1935 and was admitting physician at Cumberland Hospital until 1936. He then went to Metropolitan Hospital as Attending Physician in Cardiology, where he remained until 1948. He was a member of the Work Classification Unit, Cardiac Clinic, Bellevue Hospital, from 1950 to 1956; and since then has been a member of the similar unit at Beekman Hospital.

Irvin Klein, M.D.

DR. KLEIN is a Director of the New York State Heart Assembly, a member of its Executive Committee and Chairman of its Rehabilitation Committee. He is chairman of the sub-committee on Medical-Legal and Insurance of the Rehabiltation Committee of the American Heart Association and a member of the Committee on Cardiovascular Disease in Industry of the New York Heart Association. He is a Fellow of the Industrial Medical Association, the American College of Cardiology, the American Geriatric Society, the American Academy of Compensation Medicine, and the American College of Chest Physicians. He is a member of the Special Committee on Industrial Medicine of the Medical Society of the County of New York. DR. KLEIN is a contributing author to the Encyclopedia of Cardiology, to be published by the American College of Cardiology, and has written a number of articles for professional journals dealing with the prevention and treatment of cardiac disability and the rehabilitation and employment of those whom it strikes.

► MARCUS B. BOND, M.D., joined the Medical Department of the American Telephone and Telegraph Company in New York City on July 1, as In-Plant Resident. This represents the third and final year of his graduate training as a Fellow in Industrial Medicine of the University of Cincinnati.

At A. T. & T., DR. BOND will be associated with L. H. WHITNEY, M.D., Medical Director. He will be assigned for varying intervals of time to the Medical Departments at Headquarters, Bell Telephone Laboratories, Western Electric Company, New York Telephone Company and New Jersey Bell Telephone Company.

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People and Events

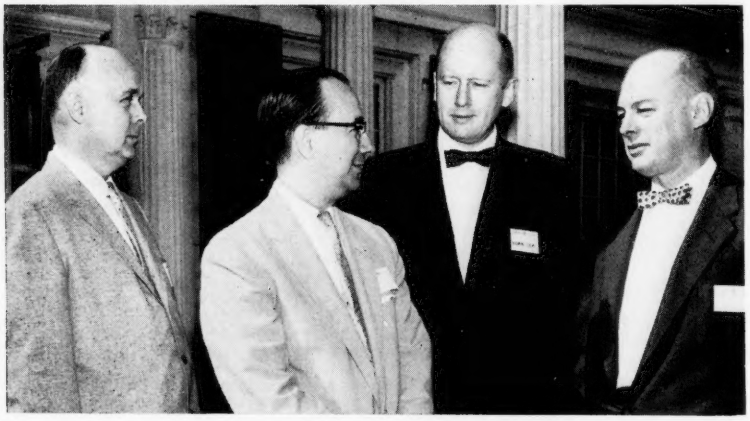
DR. BOND obtained his A.B. degree from Westminster College in Fulton, Missouri, and his M.D. degree from Washington University, St. Louis, in 1949. He interned at St. Elizabeths Hospital, Washington, D.C., and Evangelical Deaconess Hospital, St. Louis. He served as a Captain in the Army Medical Corps from 1950 to 1952. He then returned to Kansas City to enter private practice. His work led to a number of industrial affiliations. He was Assistant Surgeon for the Missouri Pacific Hospital Association before he entered the University of Cincinnati.

► BERNERD H. BURBANK, M.D., became Medical Director of the McGraw-Hill Publishing Company, New York City, on June 12. For the past three-and-a-half years, he has been assistant clinical director of Socony-Mobil Oil Co., Inc., New York City.

DR. BURBANK, a graduate of Colby College, Waterville, Maine, received his M.D. degree from Temple University, Philadelphia in 1943. From 1944-46, he served as a battalion surgeon in the Army, and saw duty in the European theater. He held the rank of major. He was in private practice in Portland, Maine, from 1947-55.

DR. BURBANK is on the teaching staff of Cornell University Medical School and is on the attending staff at New York Hospital-Cornell Medical Center. He is a member of the American Medical Association, New York State and County Medical Societies, and the Industrial Medical Association.

Small group discussions produce the essential substance of the Lake Logan Conference. These are preceded by general lectures that set the limitations of the Conference topic and the course for the deliberations. Summarizations are made by group leaders at a final, general session. Facing the camera in this picture are William C. Menninger, M.D., The Menninger Foundation, Topeka; George A. Jacoby, Director of Personnel Relations, General Motors Corporation, Detroit; Robert B. O'Connor, Medical Director, United States Steel Corp., Pittsburgh; Logan T. Robertson, M.D., Consultant, Occupational Health, Asheville, North Carolina; Harry Mushlin, M.D., Medical Director, John Hancock Mutual Life Insurance Company, Boston; and Edward J. Schowalter, M.D., Medical Director, Western Electric Company, Inc., New York City.



Pictured at the spring meeting of the Industrial Medical Association of Pittsburgh held in Erie on May 22, are (left to right): R. B. Nutter, Supervising Physician, Relations and Utilities Operation, Erie plant of General Electric Company; James Suess, M.D., Clinical Director, Warren State Hospital; Norman W. Seip, Manager, Relations and Utilities Operation, Erie Plant of General Electric; George Lehmann, Consultant, Employee Benefit Planning, General Electric Company, New York City. Dr. Suess and Mr. Lehmann presented scientific papers at the meeting.

► The Fifth Annual Lake Logan Conference, held May 8-10, concerned itself with the general topic of mental health in industry. The setting was that for which the Conference is named, a lake on the eastern slope of the Appalachians just outside of Canton, North Carolina. The resort is owned by the Champion Paper and Fibre Company and used by that firm for intra-company conferences and employee recreation. The Conference host was RUEBEN B. ROBERTSON, Chairman of the Board of the Champion Paper and Fibre Company.

The Lake Logan Conference annually brings together representatives of industrial management and specialists in industrial health, to discuss some broad question pertinent to the development of industrial medicine programs. The format used is a combination of lectures, small group discussions, and final summarizations. The tone achieved

is one of relaxed interchange of ideas, in an effort to reach clear understandings where different opinions and definitions abound. The outcomes are not published openly, and whatever results are produced remain for the most part with the participants.

The Fifth Conference's roster of some 80 persons was almost equally divided between management and professional personnel. Of the latter, half again were industrial physicians, the remainder consisting of psychiatrists, psychologists and others.

► At the 17th Annual Business Meeting of the American Association of Industrial Nurses held in Chicago, April 29, 1959, Mrs. MARGARET L. STEELE, R.N., was elected President. For the past 10 years Mrs. Steele has been Superintendent of Nurses in the St. Louis office of the American Brake Shoe Company, whose headquarters office is in New York City. She also served as plant nurse for the American Brake Shoe Company, and as a Public Health nurse in Rockport, Mass. A graduate of the Peter

Margaret L. Steele, R.N.

Bent Brigham Hospital School of Nursing, she received her B. S. degree from Simmons College School of Nursing in Boston. Mrs. Steele was former President of the St. Louis Industrial Nurses Association and is a member of various professional organizations. With this background of organizational experience and her exceptional ability, the American Association of Industrial Nurses will be assured of great achievements under Mrs. Steele's leadership.

► FRANK E. LEDER, M.D., Principal Medical Examiner of New York State Workmen's Compensation Board, has been appointed to consultant staffs in occupational and industrial medicine of Holy Family, St. Peter's and Columbus Hospitals, and Associate Attendant in physical medicine and rehabilitation at St. Vincent's Hospital in New York City. DR. LEDER is a Fellow of the Industrial Medical Association and a Diplomate of the American Board of Occupational Medicine.

► A. C. REMINGTON, M.D., who had been unable to attend the annual Industrial Health Conference in April at Chicago because of a succession of heart attacks, died on May 6, 1959, at the age of 44 years. He was Medical Director of AiResearch Manufacturing Company, a member of the Governor's Committee on the Physically Handicapped, and an outstanding worker in the affairs of Western Industrial Association. He was Secretary of the Western IMA at the time of his death.

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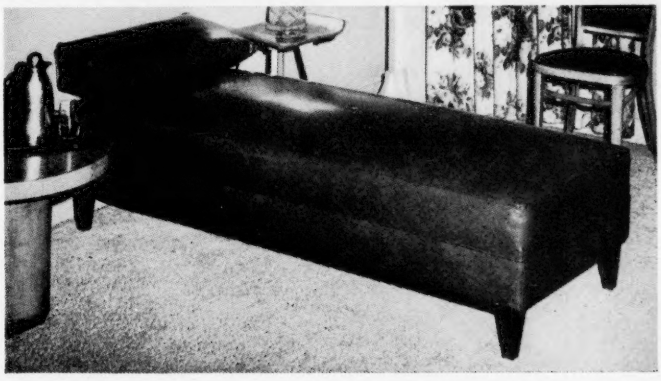

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People and Events

Born in Delta, Colorado, DR. REMINGTON received his M.D. degree from Harvard Medical School in 1940. After an internship at Rochester (New York) General Hospital, he served as a resident physician at the Psychiatric Institute of New York until his enlistment in the Army Air Corps in 1943. After three years of service, including assignments in the South Pacific, DR. REMINGTON returned to study psychoanalysis at the Compton Sanitarium and at Los Angeles Psychiatric Institute. He joined AiResearch in 1950.

At AiResearch DR. REMINGTON soon became interested in the employment, training, and placement of handicapped persons, an interest which found expression at the community level as well. He was President of the Industrial Section of the Los Angeles Medical Association in 1957, and a Fellow of the Industrial Medical Association.

A. C. Remington, M.D.

► As a tribute to the memory of four physicians who have recently died, the Western Industrial Medical Association has made a contribution to the Occupational Health Institute in the name of each. Those honored were A. C. REMINGTON, M.D., HAROLD E. SCHWING, M.D., DONALD MCNEIL, M.D., and GILBERT M. BARRETT, M.D.

► Two past-presidents of the Industrial Medical Association died during the month of June. HARRY E. MOCK, M.D., who was the Association's second president (1918-1920), and a founder of IMA, died June 30. CASSIUS H. WATSON, M.D., who was president in 1930-1931, died June 1. Discussions of their respective contributions to industrial medicine will be presented in the next issue of this JOURNAL.

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